National Park Service
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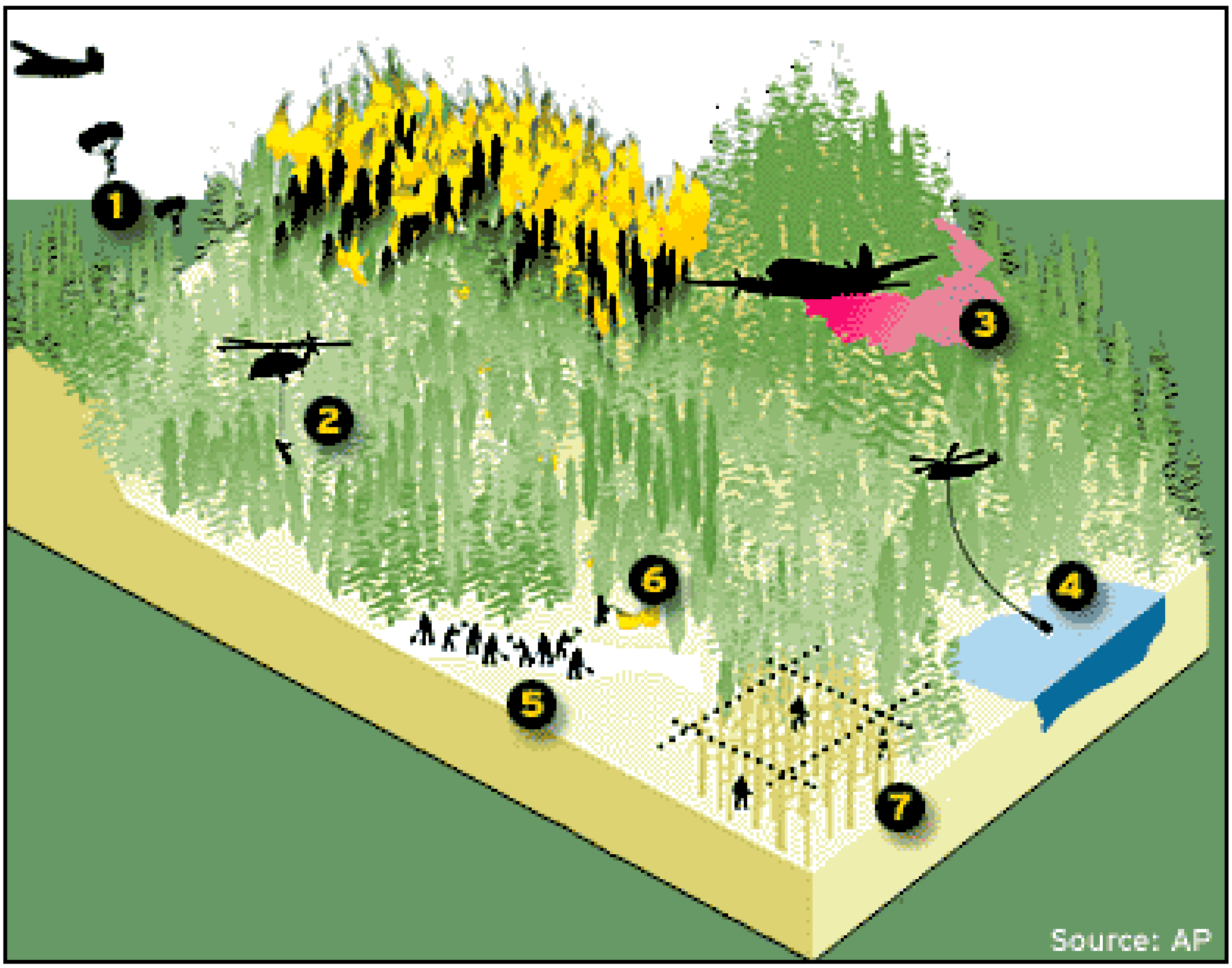
Crater Lake National Park
Crater Lake, Oregon 97604

Crater Lake National Park
Wildland Fire Resource Advisor Guide
July 2003



Seven common tactics deployed during the management of a wildfire incident. Each tactic differs in its impacts to the natural and cultural resources on-scene.

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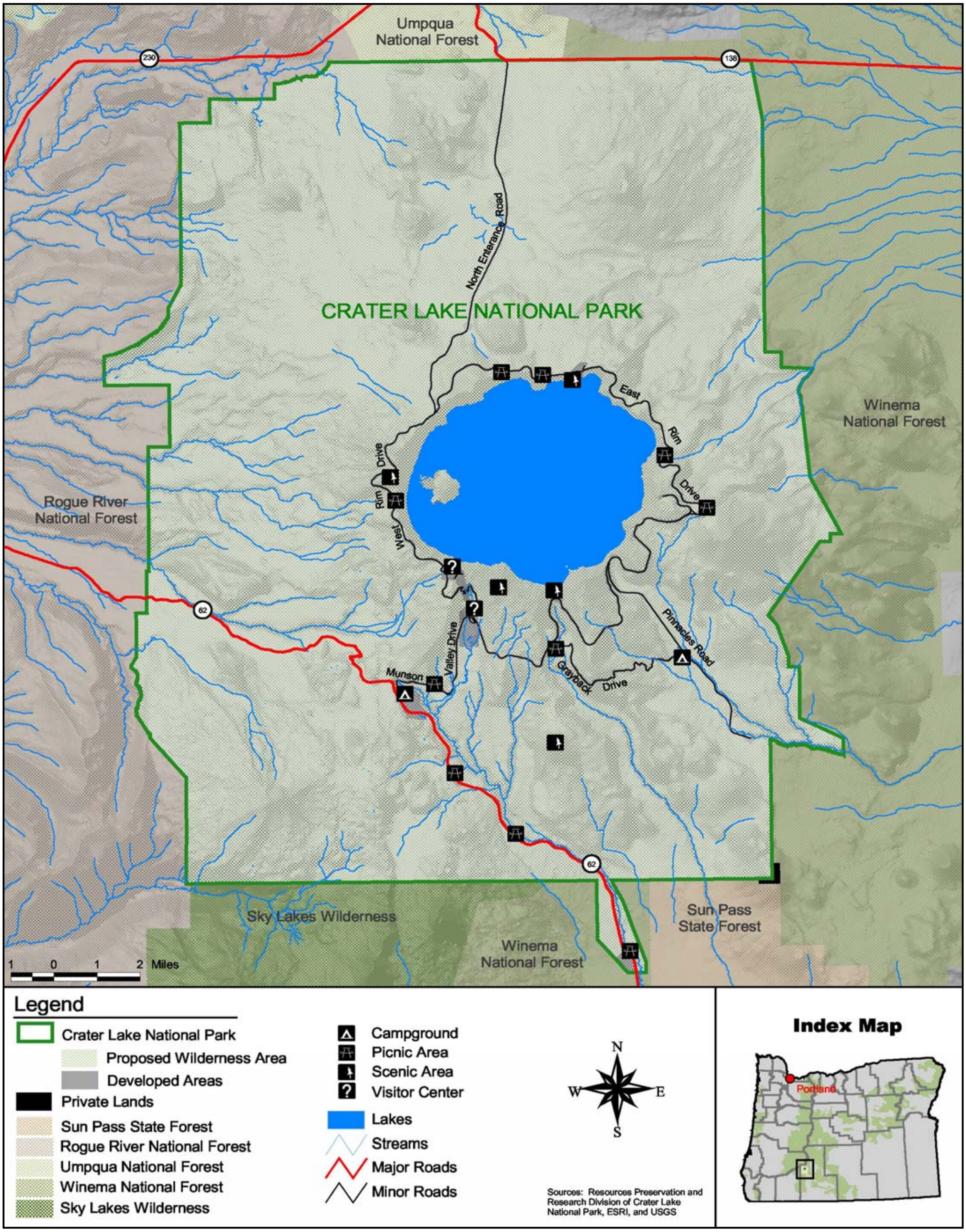

Figure 1-1. Crater Lake National Park and Vicinity

1.0 Introduction

Crater Lake National Park implements a program of wildland fire management that utilizes the benefits of fire to achieve desired natural and cultural resource conditions with concurrent goals to minimize wildland fire risks to firefighters, the visiting public, local communities, and adjacent land ownerships.

1.1 Purpose and Need for this Guide

This document describes the natural and cultural resources at Crater Lake National Park that may be impacted during wildland fire incidents. It lists resource protection and/or mitigation measures sufficient to minimize the negative impacts resulting from certain fire management actions.

The resource protection and mitigation measures listed in this document are in compliance with:

- The National Environmental Policy Act (NEPA) of 1969 (42 United States Code (USC) 4321 et seq.), which requires an environmental analysis for major Federal Actions having the potential to impact the quality of the human environment;
- The National Historic Preservation Act (NHPA) (16 USC 470), which requires protection of historic properties significant to the Nation's heritage;
- The Wilderness Act (16 USC 1131 et seq.), because the park manages areas proposed for wilderness designation;
- The Endangered Species Act of 1973 (ESA) (19 U.S.C. 1536 (c), 50 CFR 402), as the Wildland Fire Management Program affects several Federally listed species and designated critical habitat.

This guide is intended to serves as the primary reference for a Resource Advisor assigned to a wildland fire incident managed by the Park.

1.2 Background

Crater Lake National Park was established on May 22, 1902 and is the nation’s sixth oldest national park. The park was created to insure the preservation of Crater Lake and its natural surroundings. The area is characterized by a long history of volcanic and glacial activity, and Crater Lake itself lies within the 6 mile-wide caldera created by the eruption and collapse of Mt. Mazama more than 7,000 years ago.

The Park is bounded on the north by the Umpqua National Forest, on the northeast, east, and south by the Winema National Forest, on the southwest, west, and northwest by the Rogue River National Forest and Sky Lakes Wilderness Area. In addition, the Park adjoins Sun Pass State Forest and an 80-acre block of private land on the southeastern corner (See Figure 1-1). These lands are managed for a variety of uses, including timber, grazing, watershed protection, recreation and wilderness.

1.3 The Park Environment

Crater Lake National Park is located in the Southern Cascade Mountains of Oregon and contains 183,224 acres. The park contains more than 151,200 acres of burnable vegetation comprising 83% of the park’s land base. Weather-wise, the mean January and July temperatures at park Headquarters are 13.7°C and 29.6°C. The moderate seasonal extremes in temperature contrast with the precipitation. Approximately 70% of total amount occurs between November and March as snow, which usually accumulates to nearly 5 m.

Fire regimes within the park are similar to other forested areas in the southern portion of the Cascade Range with comparable plant communities and topography. Effective fire suppression at Crater Lake National Park over the last century has increased live and dead woody fuel accumulation on the forest floor and within the forest stands. Fire exclusion has unnaturally altered the landscape in some forest ecosystems. In the absence of fire, many forest communities have advanced successionally. This advancement has lead to greater stand densities, more insect/disease infestations, and greater tree mortality. In some cases, multi-storied conditions have formed continuous vertical fuel ladders. When combined with increased woody fuel, vertical fuel ladders increase the likelihood of extensive, and possibly uncontrollable crown fires.

The first step in protecting natural and cultural resources is to define the forest ecosystems in which the fire management actions will occur. From this information, the historical nature of fire in the system, the projected fire behavior, and the anticipated fire effects can be judged. There are several general ways that the forest ecosystems can be characterized. The system used at CRLA is based on classifying sites by their potential natural vegetation. There are six forest categories found at the park. Each forest series is recognized in the field by the dominant, most shade-tolerant regenerating tree species that is present over a given site (Atzet 1996). For each forest series, there are few to many tree species associated with the series that may be present depending on the successional status of the site. Table 1-1 provides a list of species that are associated with each forest series. Note that white fir and lodgepole pine occur within several forest series, representing an adaptation to a broad range of environmental conditions.

Historic fire regime characteristics have been estimated for each forest series based on fire history studies summarized by Agee (1993) and Agee and Huff (2000). The six dominant forest types (e.g. fire monitoring types) recognized within the park are listed below in Table 1-2 along with their respective historic fire disturbance characteristics. This characterization is intended as a guide for Fire and Resource Managers to identify appropriate fire management strategies, and protections for resource values at risk.

Table 1-1. Common Tree Species of Crater Lake National Park, Oregon.

Forest Series →	**Ponderosa pine**	**White fir**	**Shasta red fir**	**Mountain hemlock**	**Lodgepole pine**	**Whitebark pine**
Ponderosa pine	M	M				
Douglas-fir		M				
Incense cedar		M				
Sugar pine		m				
White fir	M	M	M			
Subalpine fir				m		
Western white pine		m	M	m		
Lodgepole pine	M	m	M	M	M	m
Shasta red fir			M	m		
Mountain hemlock			M	M		m
Whitebark pine				m		M

"M" = Major species present, "m" = Minor species present

Table 1-2. Estimated historic fire regime characteristics at Crater Lake National Park, Oregon.

Series Name	**FMU Map Color**	**Fire Regime Characteristics (BA = basal area of trees)**	**Fire Severity (% of landscape effected)**	**Mean Fire Return Interval**	**Seasonality (% of area burned)**
Ponderosa pine	Yellow	Low severity Frequent understory/surface fires < 20 % BA removed	Low: 60-95% Mod: 5-35% High: 5-10%	9 - 15 yrs.	May- Jun: 0-25% Jul-Sep: 50-75% Oct-Nov: 0-25%
White fir	Yellow	Low to moderate severity Infrequent understory/surface fires < 20% BA removed	Low: 60-90% Mod: 5-35% High: 5-10%	9 - 42 yrs.	May- Jun: 0-25% Jul-Sep: 50-75% Oct-Nov: 0-25%
Lodgepole pine	Red	Moderate to high severity Mix of surface/crown fires 20 - 70% BA removed	Low: 30-60% Mod: 20-40% High: 0-30%	60 - 80 yrs.	May-Jun: 0-5% Jul-Sep: 90-99% Oct-Nov: 0-5%
Shasta red fir	Orange	Moderate severity Mix of crown/surface fires 20 – 70% BA removed	Low: 30-60% Mod: 20-40% High: 0-30%	40 - 65 yrs.	May-Jun: 0-20% Jul-Sep: 70-90% Oct-Nov: 0-20%
Mountain hemlock	Red	High severity Stand replacing crown fires > 70% BA removed	Low: 0-10% Mod: 10-40% High: 60-90%	115+ yrs.	May-Jun: 0-5% Jul-Sep: 90-99% Oct-Nov: 0-5%
Whitebark pine	Orange	Moderate severity Mix of crown/surface fires 20 – 70% BA removed	Low: 60-90% Mod: 5-20% High: 5-20%	30-180 yrs.	May-Jun: 0-5% Jul-Sep: 90-99% Oct-Nov: 0-5%

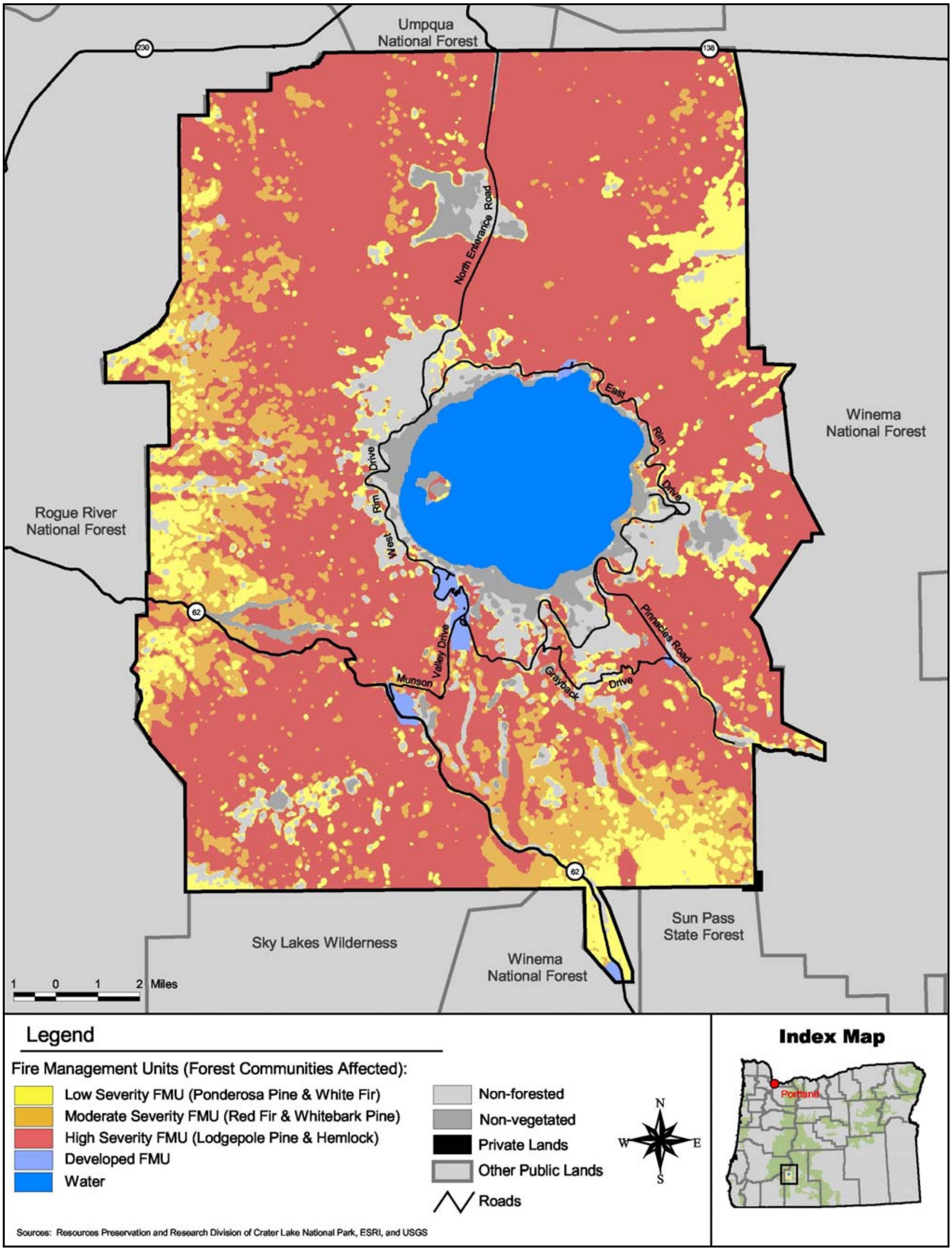

Figure 1-2. Generalized Fire Regimes and Fire Management Units for Crater Lake National Park

2.0 Forest Type Descriptions

This section describes the forest types found within the park. It includes the most current fire ecology literature for the six dominant forest types found at CRLA. General references include Agee (1993), the USDA Fire Effects Information System (FEIS) website, and other sources as cited. The descriptions are organized along an environmental gradient, starting with low elevation ponderosa pine forests and finishing with the park's high elevation whitebark pine forests.

2.1 Ponderosa Pine Forests

Environmental Characteristics

Ponderosa pine forests are found in the northeastern corner of the park, to the east of Timber Crater, at elevations up to 5500 ft above mean sea level (MSL). In this forest community, with a frequent return of fire, ponderosa pine would normally be the only conifer present. White fir is a common co-hort in ponderosa pine stands due to fire exclusion, and lodgepole pine is found in association with ponderosa pine where coarse-textured pumice soils occur, or on topographic basins where cold-air drainage forms frost-pockets. In most pre-settlement ponderosa pine forests, there was a sizable herbaceous component, which together with pine needles created a flashy fuel that encouraged frequent, widespread burning.

The Fire Regime

Historically, fires tended to be of low intensity, rarely scorching the crowns of older, mature trees. Fires tended to be small, frequent, and patchy, in that they consumed too little fuel to scar trees. The historical mean fire return interval is 9 – 15 years. Fire is linked with other disturbance factors in ponderosa pine forests, most notably post-fire insect attack. Scorched trees are more likely to be successfully attacked by western pine beetle *(Dendroctonus brevicomis)*, mountain pine beetle *(D. ponderosae)*, red turpentine beetle *(D. valens)*, or pine engraver beetles *(Ips spp.)*. Reduction in tree vigor during drought is also associated with insect attack and major losses in mature and old growth ponderosa pine occurred during the drought of the 1920's and 1930's in the Pacific Northwest. Fire may help control dwarf mistletoe infestation by pruning dead branches and consuming tree crowns that have low hanging brooms.

Stand Development Patterns

Soil moisture is more important than light for establishment of ponderosa pine seedlings. Available soil moisture is critical to seedling survival during the spring and early summer. Competition for soil water between trees and other understory plants is greatest in the 0-20 cm soil zone, within which ponderosa pine will be rooting in its first year. Presence of other understory vegetation, such as perennial grasses or mature trees, can reduce height growth of established ponderosa pine compared to open-grown trees, making the small pines more susceptible to thinning by periodic fire. Establishment on bare soil, historically provided by periodic fire, is higher than on micro sites covered by pine needles. The roots more quickly penetrate into the soil, and moisture availability may be enhanced on bare, open patches across the landscape. Shading of the seedlings can be important for protection from heat and frost by reducing incoming short-wave radiation during the day and long-wave radiation loss at night.

The process of stand development in ponderosa pine forests is a result of the shade intolerance of ponderosa pine, periodic good years for seedling establishment associated with years of above-normal precipitation, and frequent fire. Gaps in the forest, created by mortality of an existing small, even-aged group, allow the shade-intolerant pine to become established when a good seed year and appropriate climate coincide. In this opening, the stand of young trees will be protected from fire because of lack of fuel on the forest floor, while the fire will burn under mature stands and eliminate any reproduction there. As the trees in the opening continue to grow, they provide enough fuel to carry the fire and thin the stand. Within a group, relatively uniform spacing is the result of moisture competition and a tendency for closely spaced trees to be selectively killed by fire.

Fire normally maintains the forest as an aggregation of very small, even-aged or even-sized clumps. As one clump ages, it is attacked by western pine beetles and then decomposes by fire, scarifying the site for another clump to regenerate. Because of this interaction between fire and beetles, snags tend to be clustered on the landscape, and coarse woody debris is likely short-lived because of frequent fires. Consumption of coarse woody debris naturally inhibits rhizomatous grasses and shrubs and creates growing space for pine regeneration.

Mgmt. Implications

Ponderosa pine forests have experienced significant ecological change since fire suppression began. Fire exclusion has allowed a major increase in white fir density and the chances of stand-replacement fire, characteristic of high-severity fire regimes, are much greater now than historically.

Re-introducing fire within wilderness areas of the park needs careful prescription. Due to their altered fuel and forest structure, it is unlikely that fire excluded forests can absorb the shock of naturally occurring fires during the summer months. Such fires would generally be far too intense, consume too much fuel, and cause the death of many of the older, presettlement forest trees (Agee, 1993). Prescribed fire is essential to restore such sites and can be done through a series of low intensity fires. Attempts to complete the restoration in a single fire are not realistic. Autumn fires appear to harm low vigor ponderosa pines less than spring fires (Swezy and Agee 1991) in *Abies concolor* forests and it is assumed to be true for ponderosa pine forests as well. Once a series of prescribed fires has reduced surface fuel loads, fuel ladders to the overstory, and total tree density, either continued prescribed fires or natural fires can maintain the role of fire into the future of this forest type.

2.2 White Fir Forests

Environmental Characteristics

East of the Cascade Crest, white fir communities are a mix of ponderosa pine and white fir with lesser amounts of Douglas-fir, incense cedar, lodgepole and sugar pine. Historic fires favored the survival of pines over fir, and most of these stands, concentrated in the south eastern portion of the park, were historically dominated by ponderosa pine.

West of the Cascade Crest, white fir communities are found along the park's west boundary up to 5300 ft above MSL. These communities are a mix of white fir, incense cedar, and Douglas-fir as dominants with lodgepole pine, sugar pine and western white pine as minor cohorts.

The Fire Regime

Specific fire history information is available for the panhandle area of the park. Researchers studied an elevation gradient from the southern end of the panhandle up into the red fir forest types, and found an average fire return interval of 9-42 years along the gradient, with the lower average adjacent to the ponderosa pine type and the upper average adjacent to the red fir type (McNeil and Zobel 1980). Variation was high, and that probably allowed fire-intolerant white fir (at least while it was young) to survive as a co-dominant in this classic low-severity fire regime type.

Stand Development Patterns

The forest stands in the southern portion of the park are generally one-storied, and composed of small clumps. However, these clumps tend to be comprised of only one of the major species in white fir communities: one clump of ponderosa pine, another of sugar pine, another of white fir, several more of ponderosa pine, etc. Fires are frequent enough to kill most understory trees invading the clumps, so that these forest stands remained relatively open.

Understory shrubs such as gooseberries, currants, and ceanothus would either sprout after burning or reproduce from seeds stimulated to germinate by heating as the fire passed over. As in the ponderosa pine type, frequent fires maintained a low shrub/grass understory. It was probably better developed under pine clumps than under relatively shadier true fir clumps.

Mgmt. Implications

White fir forests have been significantly affected by fire exclusion. These open, mixed conifer forests have been choked by white fir regeneration and, to some extent, lodgepole pine. Most of the regeneration ceased about 1950 when growing space in the stands was fully occupied by trees. Fire hazard has significantly increased in white fir communities, and these changed stand conditions have led to increased stand susceptibility to bark beetles. Density management (thinning) and understory burning are recommended to reduce fuel buildup, reduce stand susceptibility to insects and diseases, and reduce the probability of soil damage and erosion resulting from wildfire.

Sugar pine, as a component of mixed-conifer forests, is a species of management concern. With the encroachment of white fir, sugar pine densities have declined. While somewhat shade-tolerant, sugar pine can be damaged by fire when young (Thomas and Agee 1986); while at maturity it is generally very resistant to low- to moderate-severity fires that recur at 15-25 year intervals. Mature trees have a thick, fire-resistant bark and open canopy that retards aerial spread. Sugar pine, along with western white pine and whitebark pine are susceptible to the introduced white pine blister rust and will continue to be at risk throughout their respective ranges. The use of prescribed fire will facilitate the reduction of competing species (e.g. white fir) and create openings for sugar pine regeneration.

2.3 Shasta Red Fir Forests

Environmental Characteristics

Shasta red fir forests occupy the mid-flanks of Mt. Mazama at elevations between 5300 and 6600 ft above MSL. These communities are dominated by red fir with varying amounts of lodgepole pine, with lesser amounts of western white pine and white fir. Shasta red fir is a hybrid between noble fir *(Abies procera)* and California red fir *(Abies magnifica).* Their ranges overlap between Mt. Shasta, California and the Calapooya divide, north of Crater Lake, Oregon.

The Fire Regime

Red fir ecosystems have a classic moderate-severity fire regime. Red fir, when mature, is relatively fire tolerant. Average fire frequencies of 40-70 years combined with a range of fire intensities leads to a patchy mosaic of different age structures across landscapes of this type (Chappell and Agee 1996). At Crater Lake, typical large fire sizes in red fir forests have been about 500 acres. Small patches of low, moderate, and high-severity fire typically occur, with high-severity fire often covering less than one-third of the landscape. Old-growth stands of red fir are least likely to burn with high severity.

Stand Development Patterns

Stand development patterns in red fir forests are complex because red fir is not only fire-tolerant but is also shade-tolerant. It does well with or without disturbance. Several stand development patterns are common. If no lodgepole pine is present when a stand replacement fire occurs, shrub dominance will occur (ceanothus and manzanita) with later, slow recolonization by red fir. In moderate-severity patches, some red fir dominants remain and provide seed for colonization by red fir, which does well in these partially shaded conditions, creating a multiple age class stand. In low-severity patches, understory trees are killed but little growing space is opened for regeneration, and red fir reproduces slowly in small gaps where sun flecks occur.

Mgmt. Implications

Although there has probably been some increase in older patches, red fir stands have not been affected substantially by fire exclusion over the past 80-100 years. Fire effects from natural fires appear to be within the natural range of variability.

2.4 Mountain Hemlock Forests

Environmental Characteristics

Mountain hemlock stands are the highest elevation continuous forests at the park occurring at elevations between 5600 and 7900 ft above MSL. These forests are characterized by the presence of mountain hemlock as the major climax dominant. Discontinuous stands are transitional to alpine meadows or to a whitebark pine zone at CRLA and occur in a mosaic pattern. Lodgepole pine is a common early seral species in this forest community, indicative of past disturbance by fire. Other occasional ecotonal associates include whitebark pine, Shasta red fir, and subalpine fir. The forests in the subalpine zone have a prolonged winter snowpack and a short growing season that significantly effects both the fire regime and post fire successional patterns.

The Fire Regime

Mountain hemlock is not well adapted to fire. Its life history strategy towards fire is that of an avoider. Its relatively thick bark provides some protection at maturity, but low-hanging branches, highly flammable foliage and a tendency to grow in dense groups make it very susceptible to fire injury. Mountain hemlock sites are typically moist with annual average precipitation greater than 50 inches, making the probability of fire occurrence low. South-facing slopes are more likely to burn than north-facing slopes.
Fires in these cool wet forests generally occur as infrequent crown fires. When fires do occur, they are often severe stand-replacing events, with the majority of historic fire events resulting in burned patches less than 1200 acres each. Fire return intervals for mountain hemlock forests of the Oregon Cascades are not well documented. One study by Dickman and Cook (1989) suggest intervals greater than 500 years, while Atzet (1996) reports disturbance intervals of 115 years for mountain hemlock forests in the Klamath Mountain Province of southwest Oregon.

Stand Development Patterns

Fire is the primary large-scale disturbance agent in this forest type. Most other disturbances operate at the scale of individual tree gaps or small patches (insects, disease, wind). Mountain hemlock is not adapted to grow well in open, recently burned environments. Young seedlings grow best in partial shade and early development is often slow. Mountain hemlock is very shade tolerant and often succeeds lodgepole pine when these species pioneer on drier sites. Where lodgepole pine is present, an even-aged stand of lodgepole pine will emerge from a fire disturbance, but where it is absent, the site may revert to shrubby, non-forest vegetation for more than a century after burning. Where whitebark pine is present, fires are often of moderate-severity, killing some pine but leaving other clumps intact, providing a source of seed for regeneration.

Mgmt. Implications

Fire injury makes mountain hemlock very susceptible to insects and disease. Mountain hemlock is particularly susceptible to laminated root rot *(Phellinus weirii).* This fungus spreads from infection centers along tree roots, killing infected trees in an expanding radial pattern. Active infection centers within mountain hemlock stands have been measured as large as 100 acres. These root rot pockets are characterized by numerous snags in various stages of decay with older-aged snags and downed woody debris at the center of spread.

Fire may play an important role in breaking up *Phellinus* centers, by creating conditions more suitable for the *Phellinus*-resistant lodgepole pine. The pine may then competitively exclude mountain hemlock from the site until the *Phellinus* inoculum is present only in large isolated stumps, remnants of the former stand that have not fully decayed. Dickman and Cook (1989) suggest three possible interactions between fire and fungus that depend on fire-return interval: 1) a fire-return interval of 200 years or less, resulting in dominance by lodgepole pine and disfavoring *Phellinus*; 2) a fire-return interval of 600 years, which may foster mountain hemlock stands infected with *Phellinus*, mixed with other stands dominated by lodgepole pine, much like the present landscape; and 3) absence of fire as a disturbance agent which disfavors lodgepole pine and increases the role of *Phellinus*, creating a forest landscape much different than the one seen today.

Although infrequent and unpredictable, fires have been an important force in shaping mountain hemlock forests especially where they intermingle with subalpine meadows and whitebark pine woodlands. A wildland fire use strategy may offer the most in meeting resource management objectives in this forest type, presuming that an assessment of the expected fire behavior and associated values at risk are conducted for each fire event.

2.5 Lodgepole Pine Forests

Environmental Characteristics

Pure lodgepole pine communities occur at CRLA where topo-edaphic influences result in areas with exceptionally low productivity, aggravated by continual cold air drainage. These forests are identified by the exclusive presence of lodgepole pine in both the overstory and understory, and a paucity of understory shrubs and herbs. Examples of climax lodgepole pine communities in the park include the edge surrounding the Pumice Desert, Pumice Flat, and the Wheeler and Sand Creek drainages.

These climax lodgepole communities are surrounded by others that also have lodgepole pine, such as the red fir and mountain hemlock communities. The occurrence of lodgepole pine in these communities is a good marker of past high-severity disturbances, which occurs infrequently (more than 100 years between fires) and usually replaces an entire stand with a high intensity fire. These events allow lodgepole pine to dominate sites otherwise dominated by other species. In the climax lodgepole pine forest, lodgepole pine is the dominant tree species, regardless of disturbance history.

The Fire Regime

Climax lodgepole pine forests have a mixed-severity fire regime. A combination of low, moderate, and high severity fires occurs through space and time. The magnitude of natural fires ranges from slowly burning logs across the forest floor to crown fires. Fires of low to moderate severity encourage secondary disturbance by insects and pathogens. Most lodgepole stands at the park have a patchy history of fire occurrence and spread. The average fire-free interval is 60 - 80 years, with areas bordering higher productivity forest on the low end of the range. Strong winds are likely associated with the rare stand replacement fire in the lodgepole pine type.

Stand Development Patterns

Lodgepole pine trees are usually killed by fire because of their shallow root system and thin bark. Fire prepares an ideal seedbed and lodgepole pine functions as an early post-fire colonizer. The variety of lodgepole pine in this area has non-serotinous cones *(Pinus contorta var. murrayana)*. Stands reestablish after a disturbance from off-site sources delivered by wind-dispersed seed. Most stands surveyed in the park have multiple age classes resulting from mortality due to either mountain pine beetle (*Dendroctonus ponderosae*) or past fire events. Stems killed by either agent will fall within 5-10 years, and over a 40-50 year period they maintain a hard sapwood but decayed heartwood, an ideal vector for fire spread. In the meantime, any clump of trees killed is colonized by a new generation of lodgepole pine, and this process, repeated over time, results in multiple age classes of the pines. Understory vegetation development is never substantial in these forests. Moisture competition restricts tree regeneration to gaps created after a tree falls and few herbs or shrubs tolerate these low productivity sites.

Mgmt. Implications

Climax lodgepole forests rarely grow for a century without a major disturbance by fire or insects. Within the park, both log-to-log and crown fire activity has been observed. The low productivity of these forests has limited the amount of fuel buildup and other changes due to past fire exclusion policies. These stands should be expected under most conditions to have slow-moving fires burning along logs created decades earlier by a past fire or insect disturbance. Fires moving into such stands from adjacent forest types will normally be extinguished on their own as fuels dissipate in the interior of the stand. Under most conditions, these forests will act as natural fuel breaks. However, the occurrence of past crown fires in this forest type (e.g. Prophecy Fire 1988), suggests that climax lodgepole stands cannot be considered fire barriers under all fire weather conditions.

A policy of wildland fire use may be implemented in this forest type to achieve natural values with the knowledge that human impact on such stands appears to have been minimal over the past 100 years. Under most conditions, these forests will act as natural fuel breaks, where fire suppression, if desired, will be relatively easy. Thinning treatments will enhance the effectiveness of these natural fuel breaks in areas where there are resource values at risk.

2.6 Whitebark Pine Forests

Environmental Characteristics

Whitebark pine forests occur on several thousand acres in Crater Lake National Park and represent the most expansive and diverse aggregation in southern Oregon. The majority of whitebark pine stands occur around the caldera rim above Crater Lake which is the most heavily visited portion of the park. The distribution of whitebark pine is strongly influenced by the dispersal of seeds by Clark's nutcracker. Whitebark pine occurs on dry, rocky, subalpine slopes and exposed ridges.

Whitebark pine forests east of the Cascades Crest support diverse communities with lodgepole pine, Shasta red fir, and mountain hemlock often separately co-dominating stands. Stands are generally open with an undergrowth of low shrubs, forbs and grasses. Sites where whitebark pine occurs as climax are drier than those where it is seral, such as the flanks of Mt. Scott where pure stands of whitebark pine have been observed (Murray and Rasmussen, 2003).

The Fire Regime

Moderately fire resistant, whitebark pine is favored by both creeping or intense surface and ground fires. Both types of fires kill most shade-tolerant and fire-sensitive species associated with whitebark pine such as mountain hemlock and subalpine fir. Hot surface fires that heat the cambium cause fire injury or death to these thin-barked trees. Fires of low to moderate severity can climb into trees if fuel ladders and downfall are present, thus increasing the potential of torching. The vulnerability of whitebark pine to fire is reduced by the open structure of its stands and the dry, exposed habitats with meager undergrowth in which it grows.

Estimates of fire return intervals range from 50 to 300 years depending on location. Fire may stimulate the growth of currants and gooseberries, the alternate hosts for white pine blister rust, and thus the spread of the rust into whitebark pine trees.

Most fires occurring where whitebark pines grow are ignited by lightning and do not spread very rapidly or cause severe tree injury. At CRLA, most fires in whitebark pine forests appear to be small and many burn only one clump (Agee 1993).

Stand Development Patterns

Whitebark pine exhibits high frost resistance and low shade tolerance. Fires create openings conducive to the planting of seeds by Clark's nutcrackers *(Nucifraga Columbiana)* for seedling establishment. On moister sites however, mountain hemlock and subalpine fir may out-compete whitebark pine for light and nutrient resources and limit whitebark pine regeneration.

More information is needed on fire history and the resulting development of Cascadian whitebark pine communities in Oregon and Washington.

Mgmt. Implications

Whitebark pine forests in the park, and elsewhere in the Cascades, are dying from the introduced fungus (*Cronartium rubicola*), which causes blister rust. Blister rust has been documented in the park as early as 1935. Current estimates suggest that the disease results in an overall annual decline of 0.4% for mature whitebark pine trees within the park. At that rate of decline, it is anticipated that there would be an additional 20% decline in the current whitebark pine population within 50 years (Murray and Rasmussen, 2003).

Fire exclusion may have also impacted the health and vitality of the whitebark pine stands in the park. Fire exclusion leads to less opportunity for regeneration coupled with successional advancement of competing trees.

Fire exclusion has resulted in a much smaller acreage being exposed to moderate and high severity wildfires, where new opportunities for whitebark pine regeneration could occur. If misapplied, fire could damage existing stands of whitebark pine that provide future sources of seed including blister rust-resistant strains. Additional research is needed on the fire history of Cascadian whitebark pine before park managers consider using prescribed fire as a tool to help restore declining whitebark pine communities.

3.0 Sensitive Resources

This section summarizes the sensitive resources known to occur within the park along with a list of recommended measures to ensure their protection from unintended or undesirable effects from wildland fire management actions.

3.1 Air Quality and Scenic Resources

Air Quality

Crater Lake National Park is designated as a Class 1 airshed and protecting visibility is a major concern to park management. This designation provides for the highest degree of regulatory protection from air pollution impacts. The primary means by which the protection and enhancement of air quality is accomplished is through implementation of National Ambient Air Quality Standards (NAAQS). These standards address six pollutants known to harm human health including ozone, carbon monoxide, particulate matter, sulfur dioxide, lead, and nitrogen oxides (USDA, 2000a).

The Environmental Protection Agency (EPA) further strengthened air quality protection of Class 1 areas in 1999 through the Regional Haze Rule. The rule specifies that States must review how pollution emissions within the State affect visibility at Class 1 areas across a broad region, not just those within the State. The Rule also requires States to make reasonable progress in reducing any effect this pollution has on visibility conditions in Class 1 areas and to prevent future impairment. States are required to analyze a pathway that takes the Class 1 areas from current conditions to "natural conditions" in 60 years. "Natural conditions" is a term used by the Clean Air Act, which means that no human-caused pollution can impair visibility.

All wildland fire incidents on which suppression strategies are employed are exempt from air quality regulations. It is anticipated that suppression strategies will be successful in limiting air quality problems by confine, contain, and control strategies.

Wildland fire use events generally occur over longer periods of time during the summer and are characterized by periods of lesser or greater smoke emissions depending on fuel consumption and rate of spread. These fires are coordinated with the Oregon Department of Forestry, but it is most likely that local issues at the park level will guide management controls. Typical wildland fire use tends to attract visitor interest rather than affect visitor safety or health, because they occur away from roads and have been relatively small size in comparison to the overall acreage of the park. These fires (< 4000 acres total over the season) will not cause significant degradation to air quality or visibility except for short periods.

Protection Measures

Since federal land managers (National Park Service, Forest Service, Fish and Wildlife Service, and Bureau of Land Management) were required by the Clean Air Act to protect visibility at designated Class 1 areas, these agencies established the Interagency Monitoring of Protected Visual Environments (IMPROVE) particulate monitoring network. Among other measurements, IMPROVE gathers data on particulate matter of 2.5 micrometers and 10 micrometers ($PM_{2.5}$ and PM_{10}). In addressing air pollutant emissions from fires managed for resource benefits (prescribed fire and wildland fire use), the EPA considers $PM_{2.5}$ and PM_{10} as the primary indicators of public health impacts. In general, IMPROVE uses scenery, optical, and aerosol monitoring (DOI, 2001d). Crater Lake National Park is a participant in the IMPROVE network and employs a nephalometer and fine particulate monitoring in its visibility program.

Scenic Resources

The major scenic attraction at Crater Lake National Park, as the name implies, is the lake itself. However, the vegetation is clearly an important backdrop to the lake and forms the major landscape texture element on the many vistas within the park. The park offers scenic vistas and solitude in natural settings, clean air, and clear night skies. Scenic attractions include the lake, panoramic vistas at viewpoints and along 96 ½ miles of hiking trails, wildflower viewing, and geologic land forms that include volcanic landscapes and glaciated features.

The summits of Mt. Scott, Watchman and Llao Rock offer views south to Mt. Shasta in California and north to the summits of the Three Sisters and beyond. State highway 62 is open year-round, and from it, the Munson Valley Road can be used to access the rim for lake views. Rim Drive circles the caldera rim, and has pullouts along the side for viewing the lake. From Rim Drive, a spur road leads to the Pinnacles area of volcanic spires. Other roads include the North Entrance Road, which crosses the Pumice Desert, and the South Access Road, which follows Annie Creek Canyon.

Wildland fire use will have effects primarily on background, long-distance vistas. After the first year, when most of the killed trees have browned and shed their foliage, these fires, mostly moderate severity ones, will simply add minor texture to an already heavily textured landscape created by effects of topography and soil, and different forest species composition and age classes of forests. For example, the Castle Point burn of 1986 is now indistinguishable as a fire from Rim Drive, although it burned >200 ha and is visible from the Rim. If wildland fire use occurs in the vicinity of the Rim Road, mountain hemlock are likely to die as a result, and foreground snag patches are likely to occur. For the first year or two, as the trees shed their leaves and bark, they will be unattractive, but will soon become attractive "ghost trees" and add to the forest diversity of the landscape along the highway.

Protection Measures

The visibility monitoring network of the National Park Service (IMPROVE) has not identified wildland fire use to be a significant contributor to visibility degradation in the park. However, these data are available on an annual basis and in years with significant wildland fire use activity, can be compared to years without such activity. Regional fire activity will also contribute to air quality at Crater Lake and needs to be included in the analysis.

If the impact of smoke does become significant several actions may be taken: additional fires may be classified as wildfires and suppressed; the current fire(s) may be suppressed; or the current fire(s) may be allowed to continue with smoke warnings posted for visitors and daily re-evaluations made through the decision tree.

3.2 Soil Resources

There are five major soil series found within Crater Lake National Park: Timbercrater, Umak, Llaorock, Castlecrest, and Cleetwood. Timbercrater and Umak soils are composed of pumice fragments and volcanic ash and are typically over 60 inches in depth. The surface layer of these soils is a brown, very paragravelly, ashy, loamy sand, while the subsurface layer is a lightbrown, extremely paragravelly, ashy, loamy sand or ashy sand. They generally occur in the East and Northeast portions of the park, as well as in the Panhandle in the Southeast corner (Weinheimer, 2001).

Llaorock soil is composed of volcanic ash and bedrock fragments and is typically over 60 inches in depth. The surface layer of this soil type is a dark brown, cobbly, ashy sandy loam, while the subsurface is a brown, very stony, ashy sandy loam. It primarily occurs around the crater rim and in the Southwest area of the park (Weinheimer, 2001).

Castlecrest and Cleetwood soils are composed of volcanic ash with minor components of cinders and bedrock fragments, and are typically over 60 inches in depth. The surface layer of these soils is a gray, ashy, loamy sand, while the subsurface is a light gray, ashy, loamy sand or ashy sand. Castlecrest is typically found in the valleys throughout the park, including those areas that contain the campgrounds, park headquarters, and Rim Village. Cleetwood is located in the open desert areas of the park (Weinheimer, 2001).

The above soil types range from medium to slightly acidic throughout the park. With a few exceptions (glacial soils in the western portions of the park), the majority of the soils in the park are young soils that are not well-developed or highly productive. Soil permeability is rapid for all the major soils and runoff is slow, resulting in little, if any, erosion where the soils are protected by forest cover (Weinheimer, 2001).

Protection Measures

- Heavy earth-moving equipment such as tractors, graders, bulldozers or other tracked vehicles will generally not be used for fire suppression. The Superintendent can authorize the use of heavy earth-moving equipment in extreme circumstances in the face of loss of human life and/or property;
- Crews will implement Minimum Impact Suppression Techniques (MIST) fire suppression guidelines to minimize and/or eliminate adverse soil impacts resulting from ground crew activities;
- When handline construction is required, construction standards will be issued requiring the handlines to be built with minimum impact. No handlines exposing mineral soil will be allowed through cultural sites, and all handlines will be rehabilitated. Erosion control methods will be used on slopes exceeding 10% where handline construction took place;
- All sites where improvements are made or obstructions removed will be rehabilitated to pre-fire conditions, to the extent practicable;
- Fire lines will be located outside of highly erosive areas, steep slopes, and other sensitive areas.

3.3 Water and Riparian Resources

Surface Water Resources

Waters from the slopes of Mt. Mazama flow into three major river basins: the Klamath, Rogue, and Umpqua. Runoff channels are broad and poorly defined with rounded contours since surface runoff in the park from rain and melting snow is negligible. Water sinks almost immediately into the porous volcanic soils and glacial debris and is released only slowly through evaporation, plant use, seeps, and a few springs, some of which emerge within the caldera and flow directly into the lake.

At 1,943 feet, Crater Lake is the seventh deepest lake in the world and the deepest in the United States. It is noted for its extreme water clarity and deep blue color. The lake has no surface outflows and only minor surface ground water inflows as springs along the caldera walls. The main source of water for the lake is precipitation, averaging 70 inches per year.

Wetlands and Riparian Areas

The term “wetlands” includes wet environments such as marshes, swamps and bogs. Wetlands provide critical habitats for fish and wildlife, purify water, and help check the destructive power of floods, storms, and fires. Nutrients and plant material flushed from some wetland systems during storms provide essential food for plants, fish, and wildlife in downstream ecosystems.

Crater Lake National Park wetlands include Sphagnum Bog, Thousand Springs, Boundary Springs, seeps, and creeks. Permanent streambeds in the Park generally have steep-sided channels and relatively undeveloped riparian areas associated with the streams.

In the park, riparian areas along creeks, springs, and seeps represent specialized plant communities. These plant communities provide opportunities for increased biodiversity, as they are interfaces between wetlands and drier upland habitats. These communities provide increased cover and food resources to a greater variety of animal species than are found in the drier upland or wetlands habitats. Riparian communities act as filters for down-slope soil and nutrient movement for aquatic resources, and are considered important habitat components.

Wetland values will likely be enhanced with wildland fire use. The low fire line intensities should not increase runoff or erosion hazard; most of these areas are low gradient and all contain very coarse- textured soils. Fire should have a positive effect, if any, on the hydrologic complex feeding wetlands, by reducing evapotranspirational area by killing some vegetation, and increasing annual water flow through the wetland.

Several areas within the park contain important wetland communities. These include the following areas:

1. **Boundary Springs:** located in the northwest corner of the park, approximately ½ mile from the north boundary. This is one of the headwater sources of the Rogue River. The spring produces a reliable, year-round flow in an otherwise arid area, resulting in a lush moss and herb flora.
2. **The Sand Creek/Pinnacles Area:** located near the southeast corner of the park. The entire site is of unique geological importance, with Sand Creek passing through a wide canyon with sloping walls of scoria and pumice. Along those walls are numerous pinnacle formations, many 50 feet or more in height.
3. **Thousand Springs**: located approximately 1-1/2 miles south of the west entrance (HWY 62) of Crater Lake National Park. The Thousand Springs site is a complex of freshwater springs that flow west into Union Creek and eventually into the Rogue River.
4. **Sphagnum Bog:** located along the west-central boundary of the park, this 180-acre wetland is a designated Research Natural Area. It encompasses a broad basin at the head of Crater Creek where two large springs emerge. The springs flow through a shallow gradient stream reach between expanses of mire and open forest. The site consists of a series of interconnected openings containing bog communities ranging from *Carex rostrata* sedge wetlands to *Vaccinium occidentale* bog huckleberry thickets to *Salix barclayi* willow carrs.

Protection Measures

- Creek or river crossings will be limited to set and existing locations;
- Except for spot maintenance to remove obstructions, no improvements will be made to intermittent/perennial waterways, springs or seeps, trails, or clearings in forested areas;
- Riparian areas, which have been burned, may be seeded with native seed from native genotypes, as specified in a Burned Area Emergency Rehabilitation (BAER) plan;
- Fire control strategies will be sensitive to wetland values, and firelines will not "tie" into wetland or bog margins except when relying on those areas to naturally retard the fire without constructed line;
- Crews will implemen MIST fire suppression guidelines to minimize and/or eliminate adverse impacts to surface water resources. These include:
    - Preferred use of water for aerial drops
    - Prohibition of fire retardant use in the Sun Creek Drainage, Lost Creek Drainage, and the caldera
    - Prohibition of Crater Lake, Sun Creek, and Lost Creek as water sources
    - Restriction of camps and toilet facilities from being located within 200 feet of surface water resources.

3.4 Vascular Plants

Fire plays a role in the life histories of many vegetative life forms. Fire helps maintain open habitat, encourages sexual and vegetative reproduction, and affects competing or associated plant species. Although fire may injure or kill plants, long-term effects on species may be beneficial (Hessi and Spackman 1995). Park management is concerned about the degree and extent that wildland fire management activities affect known populations of rare native species as well as invasive, non-native species.

Native Plants

Of the park's estimated 680 vascular plant species, 18 species are classified as "rare". Of those 18 rare species, 3 are species of management concern because their populations are in decline or have limited distribution to the degree that they have been listed as Federal Species of Concern:

Crater Lake rockcress (*Arabis suffrutescens* var. *horizontalis*) is found in dry and exposed rocky habitat that intermixes with sparse open forest at high elevations (Applegate, 1939).

Pumice grapefern (*Botrychium pumicola*) is an inconspicuous plant found in raw, pale pumice on rocky mountain slopes at high elevations or in frost pockets of montane lodgepole pine openings (USDA and BLM, 1999).

Mt. Mazama collomia (*Collomia Mazama*) is a perennial species of phlox that inhabits open woods and meadows of the lodgepole pine and red fir/mountain hemlock forest zones (Baldwin & Brunsfield, 2001).

Protection Measures

- If threatened, endangered, or sensitive plant species are found in a treatment unit, a buffer surrounding the plants will be imposed that prohibits physical damage to the identified population. The assigned Resource Advisor will be consulted when determining the appropriate buffer;
- Any fires occurring in the area of the Sphagnum Bog, Thousand Springs, upper Castle Creek, Copeland Creek, and Trapper Creek would be monitored for post-fire impacts to Mt. Mazama collomia.

Quaking aspen (*Populus tremuloides*) is a rare and valuable tree species in the park. The tree is very attractive to a variety of wildlife. These trees tend to create excellent cavity habitat. Birds such as Williamson's and yellow-bellied sapsuckers, screech owls, western flycatchers, mountain bluebirds, and violet-green swallows live in aspen cavities. Blue and ruffed grouse consume aspen buds. Deer and elk browse on aspen. Because grasses and forbs are able to thrive under aspen canopies, unlike dense conifer forest, ungulates find additional forage in aspen habitats. There is evidence in the park that black bears climb these trees to eat buds and catkins.

Aspen populations generally respond positively to fire. Although individual trees are very prone to fire-induced death, reproduction is positively linked to burning. In fact, fire is a critical catalyst in regeneration of aspen stands. Extensive root systems are able to sprout after fire. Furthermore, seedlings can become established via seed dispersal after fires which are followed by cool and moist weather conditions. In many places throughout the western U.S., aspen stands are dwindling due to lack of fire.

Within the park, aspen are found in small pockets in the vicinity of Sun and Annie Creeks. Perhaps the largest stand is near the west boundary of the park, north of Castle Creek. This aspen savanna is known as "Aspen Meadow." Scattered individuals are common elsewhere in the park below 6,000 feet elevation.

Protection Measures

Appropriate management responses will be aimed at doing no harm to aspen trees while also facilitating fire spread through aspen habitat wherever feasible.

- The felling of all size and health classes is prohibited except for imminent safety concerns.
- Felling for fire control purposes should not be necessary. By constructing control lines to avoid the vicinity of aspens, these trees will not present a threat of burning and falling over control lines.

Five-needled pines *(Pinus lambertiana, P. monticola, and P. albicaulis)* have been declining in the park for decades. A non-native fungal disease, white pine blister rust, kills all ages of these trees. They are called "five-needled pines" because their needles are in bundles of five. Another major attribute they share is their importance to wildlife. These three species have the largest seeds of all the park's trees. As such, a variety of animals benefit from the sustenance they provide: black bear, gray jay, chipmunks, golden-mantled ground squirrels, Clark's nutcrackers, and ravens.

Five-needled pines share a positive relationship with fire. They prefer open sites. In the absence of fire, they are easily out-competed by less fire-resistant tree species such as white fir, mountain hemlock, and noble fir. At the highest elevations in the park, the hardy whitebark pine is the only species able to thrive in the harsh conditions – forming a forest ecosystem where otherwise only sparsely vegetated ground would exist. As such, whitebark pine is considered a keystone species at places such as Mount Scott and The Watchman. Whitebark pine is also the most susceptible of the pines to the disease and is therefore the most critical of pines to manage carefully.

Similar to aspen management, fire spread through habitat of five-needled pines should be encouraged. However, unlike aspen which typically die in fires, the pines are naturally fire resistant. Where stand conditions are dense with fire-susceptible species, unnatural crown fires threaten pines. Such conditions occur in the park and present a challenge in facilitating fire while protecting the crowns of large pines.

Protection Measures

When five-needled pines occur in the vicinity of a fire, each fire needs to be independently evaluated and managed due to the variety of fire, fuel, and species composition. The Resource Advisor should ensure that the following is implemented:

- The felling of all size and health classes is prohibited except for imminent safety concerns.

- Felling for fire control purposes should be minimized. By constructing control lines to avoid the vicinity of five-needled pines, these trees will not present a threat of burning and falling over control lines.

- When safe and feasible, non-pine ladder trees (fir or mountain hemlock ≤ 15” dbh) directly beneath the pine canopy should be felled when torching is expected.

Non-Native Plants

Non-native plant species are a major threat to biodiversity in the management of natural ecosystems. Many non-native species are encouraged by disturbance, so that development, logging, and fire can all result in temporary or permanent invasion of non-native species into a national park. The park’s high elevation and mild temperatures during the growing season, limit to some extent, the threat of many non-native species found in warmer, drier climates.

Even so, Crater Lake National Park is home to 49 species of non-native vascular plants. They have been found on fewer than 150 acres throughout the park and are associated with areas that have been disturbed primarily by construction activities in the park’s developed zones. Highway 62 is a source of non-native plant introductions and the primary vector for their spread within the park. There are two species of non-native plants that pose the greatest threat of expanding their populations within the park: **spotted knapweed (*Centaurea biebersteinii*)** and **St. Johnswort (*Hypericum perforatum*).** Spotted knapweed is a state listed noxious weed. Annual efforts should be made to control known infestations within park boundaries.

Protection Measures

- Park staff will clean fire management equipment prior to its use to prevent the spread of noxious weeds;
- Park staff will stage fire management operations away from known noxious weed infestations, and will construct fire lines away from known patches.

3.5 Sensitive Fauna

Of the park’s estimated 262 faunal species, 29 species are classified as “rare”. Of those 29 rare species, 17 are species of management concern because their populations are in decline. Three (3) of these species are listed as

"Threatened" under the Endangered Species Act and the other 14 are listed as "Federal Species of Concern". A brief description for each is provided below. A complete list is of the park's rare plants and animals are included in the Appendix RAG-3. Specific mitigations are included for the three "Threatened" species.

Threatened / Endangered Fauna

Bald eagles (*Haliaeetus leucocephalus*) are known to occasionally nest near Crater Lake and use it as a feeding area. A nesting pair was observed on the lakeshore during the 2001 nesting season. Eagles prefer large, old trees for nest sites. The forest types most similar to the Klamath Basin nest sites are the white fir and ponderosa pine types.

- No direct overflights of known T&E species nest sites will be allowed below 1500 Above Ground Level (AGL) from March 15 to August 30 each year;

Northern spotted owl (*Strix occidentalis caurina*) is an old-growth dependent species that prefers complex forest structure. It is at the eastern end of its range in Crater Lake National Park. All currently known nest locations have been found within areas identified as potential habitat, but occasional sightings have been documented outside of these areas. Potential habitat is found in patches throughout the park, with higher density of patches and larger patch sizes southwest of a diagonal line connecting the northwest and southeast corners of the park. In 2001, twelve active spotted owl nesting sites were identified in the park or immediately adjacent to it.

- No direct overflights of known T&E species nest sites will be allowed below 1500 Above Ground Level (AGL) from March 15 to August 30 each year;
- All fires located within 100 acres of a known spotted owl nest or activity center, will be suppressed;
- Repetitive understory burning in spotted owl habitat will be limited to one occurrence per decade;
- During the spotted owl breeding season (March 15 to August 30), manual thinning and prescribed fire treatments will not be conducted in those portions of treatment units that are within 0.7 mile of spotted owl nest sites or activity centers;
- Prescribed fire and manual thinning treatments will be very limited in nature within 100 acres of a known spotted owl nest or activity center;
- Within 0.7 miles of any known spotted owl nest site or activity center, 40% of the area will be protected from extensive prescribed fire and manual thinning treatments, while 60% will be subject to such treatments;
- Within 1.2 miles of each known spotted owl nest site or activity center, at least 40% of the area will be protected from fire, and up to 60% will be subject to prescribed fire;

Bull trout (*Salvelinus confluentus*) are native to the Pacific Northwest and over the last 40 years has witnessed a radical decline in distribution and abundance. Bull trout probably reached maximum distribution and abundance after the last glaciation when clear cold-water streams were abundant. Habitat fragmentation, together with habitat degradation (particularly warming waters) and interspecific competition from the exotic brook trout, have led to major declines of the species.

Bull trout are found in two streams at the park: Sun Creek and Lost Creek. Non-native brook trout have been removed from the upper and middle reaches of Sun Creek to help stabilize the bull trout population. Bull trout were moved into Lost Creek following brook trout removal to reduce the risk of local extinction from a catastrophic event in Sun Creek.

Protection Measures

- To protect bull trout habitat, no more than one-half of the upper Sun Creek and Lost Creek watersheds will be allowed to burn in any 20 year period;
- Prohibition of fire retardant use in the Sun Creek Drainage, Lost Creek Drainage, and the caldera;
- Prohibition of Crater Lake, Sun Creek, and Lost Creek as water sources;

- Restriction of camps and toilet facilities from being located within 200 feet of surface water resources.

Upon locating a dead, injured, or sick endangered or threatened species specimen, initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of the cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal or fish, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. In Oregon, contact the Service's Law Enforcement Office at 541/883-6900, or the Klamath Basin Fish and Wildlife Office at 541/885-8481.

Federal Species of Concern

Amphibians/Reptiles

Tailed Frog (*Ascaphus truei*) This unique frog requires clear, cold swift-moving mountain streams primarily in older forest sites (Welsh 1990). They may be found on land during wet weather near water in humid forests or in more open habitat. During dry weather stays on moist stream-banks. This frog is sensitive to road building (Leonard et al. 1993). Disturbance that increases water temperatures and siltation may have an adverse effect on tailed frog populations (Nussbaum et al. 1983). Apparently low dispersal abilities may limit rate of recovery of depleted populations.

Cascades Frog (*Rana cascadae*) This rare frog prefers wet mountain meadows, sphagnum bogs, ponds, lakes, and streams in open coniferous forests. They hibernate in mud at the bottom of ponds and in spring-water saturated ground up to at least 75 m from pond (Briggs 1987). They also prefer quiet ponds for breeding and usually lay eggs in shallow open water. Declines in Lassen Volcanic National Park apparently are due to a combination of local factors, including (1) presence of non-native predatory fishes that have restricted available habitat and limited dispersal of frogs, (2) gradual loss of open meadows and associated aquatic habitats, and (3) loss of breeding habitat due to a five-year drought (Fellers and Drost 1993). Perhaps decline is related to sensitivity of eggs to increased levels of ultraviolet radiation resulting from ozone depletion (Blaustein et al. 1994). Increased solar radiation also may be damaging frog retinas (Fite et al. 1998).

Northern Sagebrush Lizard (*Sceloporus graciosus*) This lizard enjoys sagebrush and conifer habitats. They require well-illuminated open ground near cover. Although this species is federally designated as a species of concern, it appears to be fairly widespread in southern Oregon (Csuti et al. 1997).

Mammals

Yuma myotis (*Myotis yumanensis*) This bat is more closely associated with water than most other North American bats. It is found in a wide variety of upland and lowland habitats, including riparian, desert scrub, moist woodlands and forests, but usually found near open water (NatureServe Explorer 2002). This bat is threatened by human disturbance of maternity colonies in caves and buildings (Schmidly 1991). It frequently occurs in human structures and is vulnerable to destructive pest control activities. Some riparian management practices may be detrimental and result in loss of potential roost sites (Western Bat Working Group 1998, Arizona Game and Fish Department 1993).

Long-legged Myotis (*Myotis volans*) Primarily occurs in montane coniferous forests but also riparian and desert (Baja California) habitats. These bats may change habitats seasonally. They use caves and mines as hibernacula, but winter habits are poorly known. They are known to roost in abandoned buildings, rock crevices, under bark, etc. In summer, long-legged myotis apparently do not use caves as daytime roost site. In some areas hollow trees are the most common nursery sites, but buildings and rock crevices are also used. May be affected detrimentally by human disturbance and certain forest management practices. Residues of DDT and its metabolites have been found in Oregon individuals (Western Bat Working Group 1998).

Long-eared Myotis (*Myotis evotis*) This bat inhabits forested areas, especially those with broken rock outcrops; also shrubland, over meadows near tall timber, and along wooded streams. Often roosts in buildings, also in hollow trees, mines, caves, fissures, etc. Small maternity colonies of 12-30 individuals have been found in buildings in British Columbia. Maternity colonies, hibernacula, and roosts are vulnerable to disturbance and destruction (Mexico Department of Game and Fish 1997). Cutting of large snags is of particular concern in Arizona. Roosts under exfoliating bark may be relatively short-lived resources (New Mexico Department of Game and Fish 1997).

Silver-haired Bat (*Lasionycteris noctivagans*) This rare bat prefers forested (frequently coniferous) areas adjacent to lakes, ponds, and streams. During migration, they sometimes occurs in xeric areas. Summer roosts and nursery sites are in tree foliage, cavities, or under loose bark, sometimes in buildings. In Manitoba, migrants roosted typically in narrow crevices in tree trunks (Barclay et al. 1988). They rarely hibernate in caves and are relatively cold tolerant. Young are born and reared in tree cavities or similar situations. In South Dakota, maternity aggregations primarily were in woodpecker-created cavities in ponderosa pines (Mattson et al. 1996).

Pacific fisher (*Pennanti pacifica*) The assessment of small carnivore populations by Ruggiero and others (1994) suggests that we know little about the habitat requirements of small carnivores. However, old forest structure, including large woody debris for denning (both logs and snags), is an important structural characteristic of habitat for these animals. As they are found across a wide variety of forest types, specific forest types or dominant species are much less important than landscape structure.

Wildland fire use events at Crater Lake tend to be patchy in terms of fire severity. This patchiness historically was associated with habitat improvement for small carnivores, and will likely be associated with habitat maintenance for them in the future. High-severity patches will create prey concentration areas, moderate severity patches will create coarse woody debris, and unburned patches mixed with low severity fire patches will provide complex forest structure for these animals.

Birds

Olive-sided Flycatcher (*Contopus cooperi*) This bird breeds in forest and woodland, especially in burned-over areas with standing dead trees, subalpine coniferous forest and mixed coniferous-deciduous forest (AOU 1983). Nests are placed most often in conifers (Harrison 1978, 1979), on horizontal limbs from two to 15 m from the ground. During the non-breeding season, habitat includes a variety of forest, woodland, and open situations with scattered trees, especially where tall dead snags are present (AOU 1983). Primary habitat is mature, evergreen montane forest (Altman 1997). Causes of decline are not well known but may be related to fire exclusion. In western Oregon, nest success was substantially higher in postfire habitat than it was in several types of harvested forests (Altman and Sallabanks 2000). Fire suppression throughout the breeding range undoubtedly limits the acreage of available habitat; large areas of dense, second growth forests growing up following cutting or fires are being maintained as closed canopy forests through intensive fire control.

Willow Flycatcher (*Empidonax traillii*) As its name implies, this bird is strongly tied to brushy areas of willow and similar shrubs but is also found in thickets, open second growth with brush, swamps, wetlands, streamsides, open woodland mountain meadows and along streams. The presence of water (running water, pools, or saturated soils) and willow, alder or other deciduous riparian shrubs are essential habitat elements (Sanders and Flett 1989). It apparently does not occur in dense tree cover but will use scattered trees for song and foraging perches and gleaning substrate (USDA Forest Service 1994). In the Sierra Nevada of California, broad, flat meadows with willows and water are essential (Sanders and Flett 1989). In the Northern Rockies, is apparently restricted to riparian areas with adequate shrub cover (Hutto and Young 1999). Riparian areas are particularly vulnerable to high-intensity livestock grazing, recreation and development pressure. In Oregon, populations increased after reduction in cattle grazing and cessation of poisoning and removal of riparian willows (Taylor and Littlefield 1986).

Lewis's Woodpecker (*Melanerpes lewis*) This woodpecker nests in open forest and woodland, often logged or burned, including oak and coniferous. Distribution is closely associated with open ponderosa pine forest in western North America, and is strongly associated with fire-maintained old-growth ponderosa pine (NatureServe Explorer 2002). Because this bird catches insects from air, perches near openings or in open canopy are important for foraging habitat (Bock 1970, Tobalske 1997). Suitability of postfire habitats varies with the age, size, and intensity of the burn, density of remaining snags, and the geographic region. Birds may move to unburned stands once young fledge (Block and Brennan 1987, Tobalske 1997, Saab and Dudley 1998).

It has generally been considered a species of older burns rather than new ones, moving in several years post-fire once dead trees begin to fall and brush develops, five to thirty years after fire (Bock 1970, Block and Brennan 1987). However, on a two- to four-year-old burn in Idaho it was the most common cavity-nester, and occurred in highest nesting densities ever recorded for the species (Saab and Dudley 1998). Unlike other woodpeckers, it is not morphologically well-adapted to excavate cavities in hard wood and thus tends to nest in a natural cavity, abandoned northern flicker hole, or previously used cavity between1 and 52 meters above ground (NatureServe Explorer 2002). It sometimes will excavate a new cavity in a soft snag (standing dead tree), dead branch of a living tree, or rotting utility pole (Harrison 1979, Tobalske 1997).

White-headed Woodpecker (*Picoides albalarvatus*) The primary habitat for this woodpecker is Montane coniferous forest of pine and fir (AOU 1983). Important habitat components are an abundance of mature pines of species that produce large cones and abundant large seeds, relatively open canopy of 50-70 percent closure, and numerous snags and stumps for nest cavities (Garrett et al. 1996). Ponderosa pine, sugar pine and white fir are common associates. In Oregon and Washington, this bird is positively associated with abundance of large-diameter ponderosa pine (Marshall 1997). Specifically, in central Oregon, it inhabits multi-storied old-growth ponderosa pine forests, with canopy cover less than 51 percent; more than 12 square meters per hectare basal area of live trees (more than 53 centimeter dbh); more than 32 meters maximum canopy height, and shrub cover more than 30 percent (Dixon 1995). The bird excavates a nest cavity usually in a dead tree trunk or stump, 1-8 meters above ground. In central Oregon, woodpeckers also nest in large broken-topped snags with a large number of cavities; usually in large-diameter ponderosa pine snags (average 61 centimeter dbh, range 19-115 centimeters dbh; average 14 meters tall), but also occasionally in ponderosa pine stumps, live or dead quaking aspen, or white fir snags (Dixon 1995). In Oregon, loss of large-diameter ponderosa pine poses a significant threat to the species.

Mountain Quail (*Oreortyx pictus*) This bird inhabits brushy mountainsides, coniferous forest, forest and meadow edges, dense undergrowth, and sagebrush (AOU 1983). It has been found to favor areas with tall dense shrubs, close to water (Brennan et al. 1987). These birds may move to areas with suitable mast crops in fall. Nests are created on the ground in a shallow scrape lined with plant material. It usually nests under protective cover of a tree, shrubs, fallen branches, etc., within a few hundred meters of water. Decline in west-central and southwestern Idaho perhaps has been due to competitive exclusion by California quail, disturbance from livestock and humans during the nesting season, predation by coyote, hunting, and heavy mortality during severe winters (Spahr et al. 1991).

3.6 Cultural Resources

Cultural resources include archeological, cultural, and historic features found within the park. Numerous cultural resources exist within the park that warrant special protection from the negative impacts of fire or certain fire management activities such as smoke, heat, ground disturbance, and fire retardants, etc.

There are 25 National Register historic structures, including the Watchman Lookout, several buildings in Rim Village, and 19 buildings in the Munson Valley administrative headquarters area. The Superintendent's Residence (House 19) is listed as a National Historic Landmark. Both Munson Valley and Rim Village are listed as historic districts.

There are two eligible historic roads - Rim Drive that circles the caldera rim and the Fort Klamath – Jacksonville Wagon Road. The wagon road crosses through the park in an east-west fashion, with a section that heads west and north from Highway 62 up to the caldera rim.

There are 13 individual designed landscapes on the Cultural Landscapes Inventory (CLI). A new property type, that of a logging railroad grade, was discovered as part of a pre-burn archeological survey in 2001. There is another grade, as yet un-surveyed, in the vicinity of Bear Butte.

Overall, less than 2% of Crater Lake National Park has been surveyed in accordance with professional standards in archeology. The amount of surveyed acreage grows each year as sites are recorded prior to prescribed fire or other management activities. To date, more than 40 archeological sites and/or isolated finds have been investigated in the park.

More than 80 plant species have been identified by the Klamath Tribes as culturally important. Forty-two of these species belong to the *Carex* genera, commonly known as sedge. Sedges are grass-like plants with long and narrow parallel-veined leaves and inconspicuous flowers. They are associated with both riparian and dry meadow habitats of the park. Other common species of importance include conifer trees, willows, huckleberries, and other shrubs, forbs, and hardwood trees that are widely distributed throughout the park.

Protection Measures

The following list of mitigations will be implemented for wildland fire use and wildfire suppression actions to protect the cultural resource values within the park:

- Prior to all wildfire and wildland fire use activities, cultural resources in affected areas will be identified and avoided;
- No handlines exposing mineral soil will be allowed through cultural sites as defined or delineated in archeological survey reports;
- Fire retardant use will be prohibited in the vicinity of any historic structure, unless there is imminent threat from wildfire to the historic structure, as a last resort;
- Camps and toilet facilities are restricted from being located within 200 feet of known cultural resource sites (e.g. along Dutton Creek);
- Crews will implement Minimum Impact Suppression Techniques (MIST) fire suppression guidelines to minimize and/or eliminate adverse soil impacts resulting from ground crew activities.

3.7 Wilderness Values

Wilderness values are paramount in any park that is predominately designated or proposed wilderness, as is Crater Lake. The park manages 179,737 acres that are proposed for wilderness, pending Congressional approval and formal designation. This decision is consistent with park policy for management of wilderness, which states "for the purposes of applying NPS wilderness policies, the term 'wilderness' includes the categories of suitable, study, proposed, recommended, and designated wilderness. NPS wilderness policies apply regardless of category" (DOI, 1999b).

Under the Wilderness Act, "there shall be no commercial enterprise and no permanent road within any wilderness area designated by this chapter and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this chapter (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area" (16 USC 1133).

All management decisions affecting wilderness must be consistent with the "minimum requirement" concept as outlined in the Wilderness Act. The minimum requirement concept is intended to minimize adverse impacts on wilderness character and resources and must guide all management actions in wilderness. This requirement includes decisions concerning administrative practices, historic properties, proposed special uses, research, and equipment use in wilderness (DOI, 1999b).

Planned administrative actions that may result in an exception to a prohibited use (e.g. chainsaws, aircraft use, and mechanical equipment) or have the potential to impact wilderness resources and values must be documented in accordance with the park's minimum requirements process.

Protection Measures

- Wildland fire operations within the proposed Wilderness Area will adhere to the requirements of the Wilderness Act, NPS Management Policies, and the NPS Director's Orders 18 and 41 Wilderness Preservation and Management;

- All fire management activities within the proposed Wilderness Area will employ minimum actions and tools necessary based upon the Minimum Requirement and Minimum Tool Determination;
- All fire management activities within the proposed Wilderness Area will follow established MIST implementation guidelines;
- All fire management activities within the proposed Wilderness Area will follow established Rehabilitation Guidelines for Wilderness Fire Suppression Activities;
- A Resource Advisor should be available for advice and support with the crew(s) as well as for quality control;
- When Wilderness campsites or travel routes are closed during fire management activities, visitors will be rerouted to alternative travel routes or campsites;
- Educational/informational materials will be developed and distributed to the wilderness visitor on what to expect during fire management activities including potential noise from chainsaws during line construction, smoke dispersion, safety, helicopter and airplane use, and information on where and when these activities would occur.

3.8 Research Natural Areas

Crater Lake National Park has four Research Natural Areas (RNA): Llao Rock, Desert Creek, Sphagnum Bog, and Pumice Desert. Research Natural Areas have been established to allow natural processes to dominate and thus, facilitate research and monitoring of baseline conditions. Management is to ensure the protection of RNA ecosystems (Federal Committee on Ecological Reserves 1977).

Fire retardants and foam pose a serious threat to native biota. Terrestrial ecosystems are prone to a variety of their impacts which include: 1) inhibition of native legume (nitrogen fixers) recovery; 2) increases in invasives such as Kentucky bluegrass; 3) decreases in species richness and cover, and; 4) injury to plant tissue (Adams and Sommons 1999). If realized, these impacts would seriously compromise the ability of any RNA to serve as a baseline of natural conditions. Therefore, the use of retardant and foam are prohibited from use in RNAs except for life-threatening emergencies.

Natural fires that occur in Research Natural Areas are generally consistent with the establishment intent. The greatest possible impact on RNAs is derived from poorly conceived fire control operations rather than fire effects. Each RNA described below is unique in terms of its potential to burn and mitigating circumstances for fire management strategies (see Table 3-1).

Llao Rock RNA covers approximately 176 ha near the gently sloped broad top of Llao Rock, and includes some steep terrain on the inner caldera of Crater Lake. Although true alpine elevations are not in the Park, alpine-like conditions dominate most of the RNA, with small stringers of mountain hemlock forest on the north side and scattered whitebark pine in the subalpine zone. The subalpine zone habitat has a unique assemblage of wildflowers that are relatively few in number but are noted for their colorful flowers. Two rare plant species occur in the subalpine zone. One of the largest populations of pumice grapefern *(Botrychium pumicola),* a federal Species of Concern, is found at the site growing in light-colored, loose pumice. The second Species of Concern is the endemic Crater lake rockcress *{Arabis suffrutescens* var. *horizontalis)* that has a small population also growing in pumice substrate. Other flora and fauna are typical of the subalpine zones of the Park and associated high country.

Fire suppression activities, including aerial retardants or foam, are prohibited. The caldera zone of the RNA combined with the Rim Drive, which borders the northwest and north of the RNA, should suffice as control lines in the event that a fire starts in the RNA. Fire lines built in the RNA, particularly if they tie in to "open ground" are likely to impact the rare species that occur there.

Lightning ignitions in the RNA or in adjacent areas, should not be suppressed solely because it is likely to enter the RNA. Fire is as much a natural process there as the infertile soil or alpine climate. However, if fires do occur in the vicinity, fire monitors should seek out the rare plant populations and evaluate before-after effects on these populations. It is very unlikely that the rare plants will burn, because of their preference for open, barren-ground pumice conditions. Trampling effects of monitoring will probably be more important to avoid than fire on the landscape.

Pumice Desert RNA, a broad shallow basin surrounded by forest, is the largest RNA in the Park at 1236 ha. The site is deeply mantled by Mount Mazama pumice and has average plant cover of only 4.5%. Only 14 plant species are recorded for the area. Occasional lodgepole pine invasion has occurred along the desert's margin.

The area is not capable of carrying a fire and acts as a natural barrier or firebreak for nearby incidents. The largest fire management impact is likely to be fire suppression activities directed towards surrounding forests. Camps are prohibited within the boundaries, but the paved parking turnoff on the southern margin is an acceptable staging area and helispot.

Desert Creek RNA, consists of 757 ha in the northeastern portion of the park. It is very likely to be affected by fire. It as a central non-forested area with a bitterbrush / long-stolon sedge community, and is surrounded by three forest types: ponderosa pine / bitterbrush-manzanita / sedge, ponderosa pine / bitterbrush –snowbrush / sedge, and lodgepole pine / bitterbrush /sedge. This RNA has received notable fire management activities. The establishment report notes "the Park Service has conducted some prescribed underburns….which has benefited the ponderosa pine communities… Under natural conditions periodic fires removed understory vegetation which thus acted to fire-proof stands from more catastrophic fires. Lodgepole pine is susceptible to underburning and generally dies where this management technique is used. Underburning should continue…as it is a compatible and necessary management too."

If fire needs to be stopped in the meadow, water and foam are preferable to fire line construction. Blacklining off of historic control lines should be considered, if they are in the appropriate location to control or contain a wildfire.

Sphagnum Bog RNA lies along the west-central boundary of the park. It encompasses 73 ha of a broad basin at the head of Crater Creek where two large springs emerge. The springs flow through a shallow gradient stream reach between expanses of mire and open forest. The site consists of a series of interconnected openings containing bog communities ranging from *Carex rostrata* sedge wetlands to *Vaccinium occidentale* bog huckleberry thickets to *Salix barclayi* willow carrs. The sensitive resources here include both the unique plant communities and the hydrologic processes (water quantity and quality) that maintain the bog.

Fire suppression activities can use the bog complex as a natural firebreak, as the complex rarely burns. However, fire control strategies should not try to construct line in forested communities between bogs. The rare plant *Collomia mazama* occurs in open areas here. It is designated as a federal Species of Concern. Fire retardants should not be used in the RNA or in nearby upstream areas ("upstream" is difficult to define where surface water is so limited, but caution is needed when planning retardant drops). Wildland fire use will burn in the vicinity of the bog. As it has for centuries, moderate severity fire burned in the vicinity of the bog in 1986 (the Sphagnum Bog fire). It had no discernible effect on the bog. By killing vegetation, site evapotranspiration is reduced and may result in significantly more water present in bog ponds.

Protection Measures

- Heavy earth-moving equipment is prohibited within all Research Natural Areas;
- Helispots or camps are prohibited within the boundaries of all Research Natural Areas;
- If fire needs to be stopped in the Desert Creek RNA, water and appropriate foams will be recommended over fire line construction at the meadow edge. Phosphorous/clay based retardants will be banned within the RNA boundaries. If fire line construction is necessary, it will be best achieved at the forest-meadow edge rather than through the middle of the meadow;
- Fire suppression activities, including the use of foams and retardants, are prohibited within the Llao Rock RNA;
- Foams and retardants will not be used in the Sphagnum Bog RNA or within 200 feet of the upstream surface waters.

Table 3-1. Summary of appropriate response tactics for Research Natural Areas.

Research Natural Area	Aerial Drops	Camps	Control Line	Helispots
Desert Creek	Water Only	Prohibited	Conservative Use	Prohibited
Llao Rock	Water Only	Prohibited	Prohibited	Prohibited
Sphagnum Bog	Water Only	Prohibited	Prohibited	Prohibited
Pumice Desert	Water Only	Prohibited	Prohibited	Prohibited

3.9 Facilities and Infrastructures

There are no private in-holdings or structures within Crater Lake National Park. The majority of the administrative and visitor facilities and infrastructures are located in the developed zones of the park, including the Mazama Village, Munson Valley Headquarters, Rim Village, and South Yard areas. The park's structural fire program is employed to protect these features.

Utilities such as water, sewage, and electricity are safely housed in underground conduits. There are pump houses, gauging stations, and water tanks that are located above-ground in the Munson Valley, Annie Springs, Mazama Village, and Garfield Peak areas. A microwave tower sits atop Garfield peak. These are generally constructed of non-combustible materials.

The park has two campground facilities; Mazama and Lost Creek. Mazama Campground near the Annie Springs entrance station, has over 200 sites, running water, electricity hook-ups and a camper store. Lost Creek campground has 16 primitive camp sites located at the intersection of the Pinnacles and Grayback roads. Visitor campfires pose the highest threat to these valued resources.

There are two fire lookouts constructed of wood and stone: Watchman and Mt. Scott. Their respective locations on rocky, exposed, un-vegetated mountain peaks, make them unlikely to be damaged from wildfire. The Wineglass Cabin is a ranger cache located 40 feet off of the East Rim Drive. It is located in a forest setting and could be threatened by a careless toss of a cigarette butt.

There are numerous vault toilets and information kiosks strategically located at picnic areas and pullouts along the Rim Drives, North Entrance Road, and Highway 62. The vault toilets have a stone façade and are less likely to burn in the event of a wildfire. Information signs along the roads are subject to burning, but could be replaced if damaged or consumed by fire. Because these features are located along paved roads, the structural fire program would be employed to protect these features.

3.10 Maps of Interest

The following maps are available in the Park's Dispatch Office. They are intended to provide site-specific guidance for the recommendations. They are not included in the Guide itself because of the sensitive nature of the resources:

- *Wilderness Areas and Research Natural Areas*
- *Sensitive* Locales
- *Spotted Owl Activity and Potential Habitat*
- *Archeological and Historical Locations*
- *Wetlands of Crater Lake National Park*

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RAG Appendix 1

Rare Animal Species of Crater Lake NP
March 2003

Common Name	Scientific Name	Federal Listing	Federal Species of Concern	State Rank*
Northern spotted owl	*Strix occidentalis caurina*	Threatened		1
Bull trout	*Salvelinus confluentus*	Threatened		1
Crater Lake Newt	*Taricha granulosa ssp.mazamae*			1
Crater Lake tightcoil (snail)	*Pristiloma arcticum crateris*			1
Bald Eagle	*Haliaeetus leucocephalus*	Threatened		2
Tailed frog	*Ascaphcs truei*		Y	2
Cascade frog	*Rana cascadae*		Y	2
Northern goshawk	*Accipiter gartilis*		Y	2
Peregrine falcon	*Falco peregrinus anatcm*			2
Pacific fisher	*Martes pennanti pacifica*		Y	2
California wolverine	*Gulo gulo luteus*			2
Western Gray Squirrel	*Sciurus griseus*			3
Yuma Myotis	*Myotis yumanensis*		Y	4
Long-legged Myotis	*Myotis volans*		Y	4
Long-eared Myotis	*Myotis evotis*		Y	4
Silver-haired Bat	*Lasionycteris noctivagans*		Y	4
Olive-sided Flycatcher	*Contopus cooperi*		Y	4
Willow Flycatcher	*Empidonax traillii*		Y	4
Lewis' Woodpecker	*Melanerpes lewis*		Y	4
White-headed Woodpecker	*Picoides albolarvatus*		Y	4
Northern Sagebrush Lizard	*Sceloporus graciosus*		Y	4
Mountain Quail	*Oreortyx pictus*		Y	4
American Marten	*Martes americana*			4
Bufflehead	*Bucephala albeola*			4
Barrow's Goldeneye	*Bucephala islandica*			4
Black-backed Woodpecker	*Picoides arcticus*			4
Three-toed Woodpecker	*Picoides tridactylus*			4
Great Gray Owl	*Strix nebulosa*			4
Ringtail	*Bassariscus astutus*			4

*1=Threatened or Endangered Throughout Range, 2=Threatened, Endangered or Extirpated from Oregon but Secure Elsewhere, 3=In Review, 4=Watch List

RAG Appendix 2

Rare Plant Species of Crater Lake NP
March 2003

Common Name	Scientific Name	Federal Species of Concern	State Rank*
Crater Lake Rockcress	*Arabis suffrutescens horizontalis*	Y	1
Pumice Grapefern	*Botrychium pumicola*	Y	1
Mt. Mazama Collomia	*Collomia mazama*	Y	1
Shasta Arnica	*Arnica viscosa*		2
Lance-Leaved or Triangle Moonwort	*Botrychium lanceolatum var.*		2
Abrupt-Beaked Sedge	*Carex abrupta*		2
Crawford's Sedge	*Carex crawfordii*		2
Lesser Bladderwort	*Utricularia minor*		2
Swamp Willow-Herb	*Epilobium palustre*		3
Greene's Hawkweed	*Hieracium greenei*		3
Shaggy Hawkweed	*Hieracium horridum*		3
White Stem Gooseberry	*Ribes inerme var. klamathense*		3
Few-Flowered Mannagrass	*Torreyochloa erecta*		3
Bolander's Bluegrass	*Poa bolanderi*		3
Oarleaf Buckwheat	*Eriogonum pyrolifolium var.*		3
California Mountain Ash	*Sorbus californica*		3
Pine Woods Cryptantha	*Cryptantha simulans*		3
Bolander's Hawkweed	*Hieracium bolanderi*		4

*1=Threatened or Endangered Throughout Range, 2=Threatened, Endangered or Extirpated from Oregon but Secure Elsewhere, 3=In Review, 4=Watch List

RAG Appendix 3

Summary of Resource Protection Measures

The Park Superintendent's signature on the Crater Lake Fire Management Plan NEPA documents (FONSI, February 2003) commits the NPS to a contract with the general public to minimize impacts to the natural and cultural resources of the park through the implementation and evaluation of the following mitigation measures.

As stated in Finding of No Significant Impacts (FONSI) document for the fire management plan, "All fire incidents within Crater Lake National Park will be monitored, and each mitigation measure listed below will be evaluated to determine 1) if it was implemented as stated, and 2) to evaluate if it was effective at mitigating the impact to the resource it was designed to protect. Monitoring reports will become part of the permanent record of each fire event."

Fire Management Activities:

- Whenever consistent with safe, effective suppression techniques, the use of natural barriers will be used as extensively as possible;
- Fire retardant agents must be on an approved list for use by the Forest Service and Bureau of Land Management;
- Heavy earth-moving equipment such as tractors, graders, bulldozers or other tracked vehicles will generally not be used for fire suppression. The Superintendent can authorize the use of heavy earth-moving equipment in extreme circumstances in the face of loss of human life and/or property;
- When handline construction is required, construction standards will be issued requiring the handlines to be built with minimum impact. No handlines exposing mineral soil will be allowed through cultural sites, and all handlines will be rehabilitated. Erosion control methods will be used on slopes exceeding 10% where handline construction took place;
- All sites where improvements are made or obstructions removed will be rehabilitated to pre-fire conditions, to the extent practicable;
- A rehabilitation plan as required by NPS-18, with the use of a Burned Area Emergency Rehabilitation (BAER) Team, will be formulated and implemented in advance of demobilization from major fire events.

Wilderness Resources

- Wildland fire operations within the proposed Wilderness Area will adhere to the requirements of the Wilderness Act, NPS Management Policies, and the NPS Director's Orders 18 and 41 Wilderness Preservation and Management;
- All fire management activities within the proposed Wilderness Area will employ minimum actions and tools necessary based upon the Minimum Requirement and Minimum Tool Determination;
- All fire management activities within the proposed Wilderness Area will follow established MIST implementation guidelines;
- All fire management activities within the proposed Wilderness Area will follow established Rehabilitation Guidelines for Wilderness Fire Suppression Activities;
- A Resource Advisor should be available for advice and support with the crew(s) as well as for quality control;
- When Wilderness campsites or travel routes are closed during fire management activities, visitors will be rerouted to alternative travel routes or campsites;
- Educational/informational materials will be developed and distributed to the wilderness visitor on what to expect during fire management activities including potential noise from chainsaws during line construction, smoke dispersion, safety, helicopter and airplane use, and information on where and when these activities would occur;

Cultural Resources

- No handlines exposing mineral soil will be allowed through cultural sites;
- Prior to all wildfire and wildland fire use activities, cultural resources in affected areas will be identified and avoided;
- Fire retardant use will be prohibited in the vicinity of any historic structure, unless there is imminent threat from wildfire to the historic structure;

Research Natural Areas

- Heavy earth-moving equipment is prohibited within all Research Natural Areas;
- Helispots or camps are prohibited within the boundaries of all Research Natural Areas;
- If fire needs to be stopped in the Desert Creek RNA, water and appropriate foams will be recommended over fire line construction at the meadow edge. Phosphorous/clay based retardants will be banned within the RNA boundaries. If fire line construction is necessary, it will be best achieved at the forest-meadow edge rather than through the middle of the meadow;
- Fire suppression activities, including the use of foams and retardants, are prohibited within the Llao Rock RNA;
- Foams and retardants will not be used in the Sphagnum Bog RNA or within 200 feet of the upstream surface waters.

Soil and Water Resources

- Creek or river crossings will be limited to set and existing locations;
- Except for spot maintenance to remove obstructions, no improvements will be made to intermittent/perennial waterways, springs or seeps, trails, or clearings in forested areas;
- Riparian areas, which have been burned, may be seeded with native seed from native genotypes, as specified in a Burned Area Emergency Rehabilitation (BAER) plan;
- Fire lines will be located outside of highly erosive areas, steep slopes, and other sensitive areas;
- Fire control strategies will be sensitive to wetland values, and firelines will not "tie" into wetland or bog margins except when relying on those areas to naturally retard the fire without constructed line;
- Crews will implement Minimum Impact Suppression Techniques (MIST) fire suppression guidelines to minimize and/or eliminate adverse soil impacts resulting from ground crew activities;
- Crews will implementation MIST fire suppression guidelines to minimize and/or eliminate adverse impacts to surface water resources. These include:

    - Preferred use of water for aerial drops
    - Prohibition of fire retardant use in the Sun Creek Drainage, Lost Creek Drainage, and the caldera
    - Prohibition of Crater Lake, Sun Creek, and Lost Creek as water sources
    - Restriction of camps and toilet facilities from being located within 200 feet of surface water resources;

Wildlife and Plants

- All fires located within 100 acres of a known spotted owl nest or activity center, will be suppressed;
- Repetitive understory burning in spotted owl habitat will be limited to one occurrence per decade;
- No direct overflights of known T&E species nest sites will be allowed below 1500 Above Ground Level (AGL) from March 15 to August 30 each year;
- Within 1.2 miles of each known spotted owl nest site or activity center, at least 40% of the area will be protected from fire, and up to 60% may be subject to prescribed fire;

- To protect bull trout habitat, no more than one-half of the upper Sun Creek and Lost Creek watersheds will be allowed to burn in any 20 year period;
- If threatened, endangered, or sensitive plant species are found in a treatment unit, a buffer surrounding the plants will be imposed that prohibits physical damage to the identified population. The assigned Resource Advisor will be consulted when determining the appropriate buffer;
- Park staff will clean fire management equipment prior to its use to prevent the spread of noxious weeds;
- Park staff will stage fire management operations away from known noxious weed infestations, and will construct fire lines away from known patches;
- Any fires occurring in the area of the Sphagnum Bog, Thousand Springs, upper Castle Creek, Copeland Creek, and Trapper Creek would be monitored for post-fire impacts to Mt. Mazama collomia.
- The felling of all size and health classes of aspen is prohibited except for imminent safety concerns.
- The felling of all size and health classes of five-needled pine tree species is prohibited except for imminent safety concerns.
- When safe and feasible, non-pine ladder trees (fir or mountain hemlock ≤ 15” dbh) directly beneath the pine canopy should be felled when torching of pine trees is expected.

Table 1. List of responsible officials for mitigation measures that are integral to the proposed action.

Mitigation Category	Responsible Official	Monitoring Period
Fire Management Activities	**Incident Commander/ Burn Boss**	**Every fire event**
Visitor Experience and Use	**Incident Commander/ Burn Boss**	**Every fire event**
Soil and Water Resources	**Resource Advisor**	**Each fire event**
Wildlife and Plants	**Resource Advisor**	**Each fire event**
Cultural Resources	**Resource Advisor**	**Each fire event**
Wilderness Resources	**Resource Advisor**	**Each fire event**
Research Natural Areas	**Resource Advisor**	**Each fire event**

RAG Appendix 4

Minimum Impact Suppression Tactics (MIST) Guidelines

On all wildland fire management actions, use of minimum impact tactics is the policy of the National Park Service (RM-18, chap. 9: 1999). Minimum impact tactics are defined as the application of those techniques which effectively accomplish wildland fire management objectives with the least cultural and environmental impact, commensurate with public and firefighter safety.

Accomplishments of minimum impact fire management techniques originate with instructions that are understandable, stated in measurable terms, and communicated both verbally and in writing.
Evaluation of these tactics both during and after implementation will further the understanding and achievement of good land stewardship ethics during fire management activities.

The following guidelines are for park superintendents, incident management teams and firefighters to consider. Some or all of these items may apply, depending on the situation.

Consider:

Command and General Staff:

- Evaluate each and every suppression tactic during planning and strategy sessions to see that they meet superintendent's objectives and MIST guidelines.
- Include agency resource advisor and/or local representative in above session.
- Discuss MIST guidelines with overhead during overhead briefings, to gain full understanding of tactics.
- Ensure MIST are implemented during all resource disturbing activities.

Planning Section:

- Use Resource Advisor to evaluate that management tactics are commensurate with land/resource objectives, and incident objectives.
- Use an assessment team to get a different perspective of the situation.
- Adjust line production rates to reflect application of MIST.
- Ensure that instructions for MIST are listed in the incident action plan.
- Anticipate fire behavior and ensure all instructions can be implemented safely.
- Motor vehicle and heavy equipment use is limited to existing roads.

Operations Section:

- Chain saws, helicopters, air tankers, or pumps can be used when essential to meet suppression objectives, but with due consideration to impacts on wilderness character and subject to minimum tool determination.
- Helicopters are restricted to natural landing sites when available and will not occur in Research Natural Areas or other sensitive sites identified by the Resource Advisor.
- Water drops are preferred over fire retardant. Retardants are prohibited in the Sun Creek watershed, in the Lost Creek watershed, or in the caldera. Crater Lake will not be used as a water source.
- Motor vehicle and heavy equipment use is limited to existing roads.
- Emphasize MIST during each operational period.
- Explain expectations for instructions listed in incident action plan.
- Monitor suppression tactics/conditions.

Logistics Section:

- Ensure that actions performed around areas other than the Incident Command Post (ICP), i.e. dump sites, camps, staging areas, Helispots, etc., result in minimum impact upon the environment.

Division/ Group Supervisor, Strike Team/Task Force Leader and Crew Superintendents:

- Discuss MIST with crews.
- Monitor suppression tactics/conditions and ensure expected results are achieved.
- Look for opportunities to further minimize impact to land and resources during suppression and mop-up phases.

MIST Standards

Safety

- Constantly review and apply the 18 Situations that Shout Wacthout and the 10 Standard Fire Orders.
- Be particularly cautious with:
    - Burning snags you allow to burn down;
    - Burning or partially burning live and dead trees;
    - Unburned fuel between you and the fire.

Fire Lining Phase

- Select procedures, tools, and equipment that least impact the environment.
- Consider the use of water (wetlining) as a firelining tactic.
- Allow fire to burn to natural barriers where possible.
- Use cold-trail, wet line or a combination when appropriate.
- Firelines will be located to take advantage of natural barriers, rock outcroppings, trails, streams, etc.
- Firelines will be no wider than necessary to stop the spread of the fire.
- Minimize bucking and cutting of trees to establish fireline; locate fire line around logs when possible.
- Limb vegetation adjacent to fireline only as needed to prevent additional fire spread.
- During fireline construction, cut shrubs or small trees only when necessary. Make all cuts flush with the ground.
- Burning snags will be felled only when they are a definite threat to fall across the fire line or to the safety of firefighters. Otherwise, they will be allowed to burn down naturally.
- Identify hazard trees with a lookout or flagging.
- Scattering of unburned fuels, rather than consolidated boneyards is encouraged.

Mop-up Phase

- Use infra-red detection devices along perimeters to detect hot spots.
- Cold-trail charred logs near fireline; do minimal tool scarring.
- Minimize bucking of logs to extinguish fire or to check for hotspots; roll the logs instead if possible.
- Return logs to original position after checking and when ground is cool.
- Consider allowing large logs to burnout.
- Remove or limb only those fuels which if ignited have potential to spread dire outside the fireline.
- Use water or dirt to extinguish burning trees/snags. Fell only if trees/snags pose serious threat of spreading firebrands.
- Before felling consider allowing burning trees/snags to burn themselves out. Ensure adequate safety measures are communicated when this option is chosen.
- Identify hazard trees with a lookout or flagging.
- Align saw cuts to minimize visual impacts from heavily-used travel corridors. Slope cut away from line of sight when possible.

Camp Sites and Personal Conduct

- Facilities (fire camps and helispots) will be located outside of backcountry whenever possible.

- Use of existing campsites is preferred, rather than creating new ones.
- Avoid all sensitive areas as identified by the Resource Advisor.
- Use leave no trace" camping techniques.
- Select impact-resistant sites such as rocky or sandy soil, or openings within heavy timber.
- Camping is prohibited in meadows, or within 200 feet of any surface water.
- Minimize disturbance to land when preparing bedding sites. Do not clear vegetation or trench to create bedding sites.
- Establish several small camps rather than one large one.
- Camps will be a minimum of 200 feet away from water sources.
- Toilet facilities, if not managed through portable facilities, will be a minimum of 200 feet away from water sources.
- Multiple and varying travel routes will be used to the fire, sources of water, and helispots.
- Nails will not be used in trees.
- Use stoves for cooking when possible. If a campfire is used, limit to one site and keep it small as reasonable. Avoid use of rocks to ring fires.
- Use down and dead firewood. Use small diameter wood, which burns down more cleanly.
- Don't burn plastics or aluminum – pack it out with other garbage.
- Keep a clean camp and store food and garbage so it is unavailable to bears.

Rehabilitation Standards

- Control lines will be backfilled and scarified. Replace dug-out soil and/or duff and obliterate any berms created during fireline construction.
- On slopes greater than 10%, waterbars will be constructed every 200 ft along impacted trails.
- Where soil has been exposed and compacted, such as in camps, on user-trails, at helispots and pump sites, scarify the top 2-4 inches and scatter with needles, twigs, rocks, and dead branches.
- Blend campsites with natural surroundings, by filling in and covering latrine with soil, rocks, and other natural material.
- Naturalize campfire area by scattering ashes and returning site to a natural appearance.
- Where trees were cut or limbed, cut stumps flush with ground, scatter limbs and boles, out of sight in unburned area.
- Cut stumps will be flush cut and covered with soil, moss, etc.
- Position felled/bucked material so as to be least noticeable to visitors and camouflage where possible.
- Pack out all garbage and unburnable material.
- Remove all signs of human activity (plastic flagging, small pieces of aluminum foil, litter, etc.)
- A rehabilitation plan as required by NPS-18 with the use of Burned Area Emergency Rehabilitation (BAER) Teams will be formulated and implemented in advance of demobilization for complex incidents.