Appendix D. Rare Habitats and Species of the Klamath Network.

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1.1. Overview

In large-scale monitoring and conservation programs, such as the National Park Service (NPS) Inventory and Monitoring (I&M) Program, rare habitats and species may be under-represented, but disproportionately important or imperiled (Stohlgren et al. 1997, Kaye et al. 1997). These focal species and special landscape elements are important for conservation and merit special consideration during the development of a comprehensive monitoring program (Noss 2004).

Many approaches to monitor and conserve biological diversity have stressed the importance of habitat conservation as a vehicle to conserve species (reviewed in Noss et al. 1997). Both resource management and conservation biology often give considerable attention to rare habitats in a monitoring framework, which may be especially important in the Klamath region. Many of the region's endemic species are associated with unique hydrologic or edaphic sites, such as serpentine soils, rocky outcrops, cliffs, rock crevices, or wetlands, which provide local refugia from competition, predation, adverse microclimates, or fire (Coleman and Kruckeberg 1999, Beever 2002). In addition, rare habitats contribute significantly to increasing NPS units' landscape diversity. Finally, some of these rare environment types may act as keystone habitats (*sensu* Stohlgren et al. 1997), as in the case of springs, ephemeral water sources, and aspen groves.

At the same time, there is great value in better understanding the ecology and life history of the rare species themselves. Although an integrated view of biodiversity would encompass a vast array of species and processes in any landscape, rare, threatened, and endangered species draw disproportionate attention because they are especially imperiled, charismatic or otherwise well known, and protected by law. While it is clear that we are only beginning to understand the ecology of many rare taxa, such as soil arthropods, others are sufficiently well-known to merit inclusion in a monitoring program.

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

In many, but by no means all cases, rare habitats and species are closely linked in time and space. Therefore, in this appendix we review information about the types and particular rare habitats and species in the Klamath Network (KLMN) parks. For each section, we present an overview of relevant theory pertinent to defining types of rarity. Next, we provide a few known examples of rare habitats or species. Since our current knowledge of rare species and habitats is limited, we do not provide a complete list here. Rather, we present general principles to provide a framework for rarity and populate this framework with examples where knowledge or data are available.

1.2. Rare Habitats of the Klamath Network Parks

As described in Chapter One, the Klamath region is a physically complex and biologically diverse landscape. In fact, the western and southern portions of the region have been designated as among of the globe's 25 "biodiversity hotspots" (Myers et al. 2000). Persistence of this diversity depends upon developing a better understanding of the rare and unique habitats of the region and an ability to document condition trends through time. For this reason, we first discuss rare habitats and then discuss rare species.

Although habitat rarity may be defined in many ways, we believe it is important to recognize that habitats may not only be rare spatially, but also temporally. Examples of habitats that have a time-limited presence on the landscape include ephemeral springs or pools in semiarid regions, snowpacks or snowmelt pools, early-successional habitats following disturbances, and unique structural features (e.g., cat-face scars, mistletoe brooms) that form in vegetation.

In the following subsection, we discuss rare habitats in each of the three ecosystem domains discussed in the main body of the report: (1) Aquatic, (2) Terrestrial, and (3) Subterranean. We support the authority of park staff to highlight park rare or special status habitats based on either local or regional rarity, as well as a recognition that a habitat has exceptional ecological or interpretive importance to the park(s).

Rare Habitat Types: Aquatic

Marine: Along the more than 50 km of shoreline within Redwood National and State Parks, unique spatially delimited habitats abound. Sea stacks, blowholes, sea bluffs, estuaries, and sea caves are all represented. Most of these habitats are park-rare, meaning that although they are seen along much of the north Pacific Coast, they are rare within the park and Network. The coastline is one of the least understood parts of the KLMN, so rare coastal habitats have yet to be defined authoritatively.

Freshwater: Although aquatic environments are not particularly uncommon in the wetter parks, small, isolated seeps and wetlands are certainly rare at the landscape scale and poorly understood at the landscape scale in most of the parks. These habitats are known to harbor globally rare plant species; such habitats often contain localized populations of mollusks, crustaceans, or other disjunct species with low dispersal abilities (Marcot 1997). This is especially the case when the wetlands have unique geochemistry (e.g., serpentine fens).

Within larger lakes, unique subhabitats are just beginning to be explored. For example, the greatest depths in Crater Lake represent a continentally rare habitat, characterized by low light levels, colder and stable water temperatures, and high pressure. While much remains to be learned about these deepwater habitats, they may contain distinctive invertebrates and microorganisms.

Geothermal environments are also locally important in the Cascades parks. The hot springs and fumaroles at Lassen likely support an interesting thermophilic microfauna (Siering and Wilson. 2001). Geothermal influences along the floor of Crater Lake have long been suggested based on increases in water temperature depth (Collier et al. 1990).

Rare Habitat Types: Terrestrial

Climatically rare or disjunct habitats are an important dimension of habitat diversity in the KLMN. Although the coastal fog zone is locally extensive, it is a regionally rare habitat with a number of associated species (e.g., coast redwood (*Sequoia sempervirens*)). Even more closely restricted to the coastal strip are the areas of salt spray along the coastal bluffs and headlands. These sites, where the environment is too rigorous for the coast redwood, have a wealth of species that are either more tolerant of salt spray, such as Sitka spruce (*Picea sitchensis*), or require more light, such as shore pine (*Pinus contorta* ssp. *contorta*) and a number of coastal sage scrub plant genera (*Baccharis*, *Ceanothus*).

Subalpine and alpine areas are also unique climatic zones in the higher elevation parks. During the last two decades, these areas have attracted increasing attention, because of their increased vulnerability to climate change. As Peters and Darling (1985) postulated, Thomas et al. (2004) modeled, and Beever et al. (2003) and others have demonstrated empirically with field data, increased temperatures due to rapid climate change can force the elevational distribution of species upslope, effectively pushing the distribution of species “off” the mountain, resulting in local extirpation or extinction. This is especially true for species with poor dispersal capabilities or at very high elevations since they are less able to migrate to comparable habitats at more northern latitudes. Within the alpine and subalpine zones, specific subhabitats, such as permanent snow fields, snowmelt beds, and cirques, are even more spatially limited. For example, two bryophytes with arctic-alpine distributions (*Andreaea nivalis* and *Polytrichum sexangulare*) reach the southern extreme of their range in late snow melt beds at Lassen (Showers 1982). Tracking conditions of elevationally limited habitats and associated species will be an important dimension of a landscape scale monitoring program.

Within the terrestrial environment, areas with unique physical structure such as rocky outcrop areas, talus slopes, dunes, cliffs, and lava flows often provide unique habitat for plant and animals species. Cliff faces, which represent little more than a line in a two-dimensional depiction of a landscape’s habitats, provide two important functions for conservation of natural resources: 1) they are used obligately by many taxa, including volant species such as cliff swallows (*Petrochelidon pyrrhonota*), sea birds such as puffins and auklets (Bakker 1971), and bats, as well as numerous vascular plant species (e.g., *Sedum spathulifolium*); and 2) they harbor a disproportionately large percentage of the rare bryophyte taxa within an ecoregion (Vitt and Belland 1997). In addition, because they are largely inaccessible, cliff areas are increasingly used as reference areas for gauging human impacts (Larson et al. 1999).

Often, but not exclusively, found in these alpine and subalpine habitats, talus slopes represent another rare habitat type within the KLMN. These environments harbor obligate species, such as the American pika (*Ochotona princeps*), or more facultative associates, such as the yellow-bellied marmot (*Marmota flaviventris)* and the bushy-tailed woodrat (*Neotoma cinerea*). Extrusive volcanic deposits (e.g., *aa* lava flows) provide habitats that are similar to talus. Although these craggy, rough, convoluted rocks are not a rare habitat within Lava Beds, they are a regionally rare and unique habitat.

Soils or parent materials with distinctive geochemistry that affect the resources available to plants are especially important habitats in the Klamath region. Serpentine soils, for example, are often associated with rare and endemic plant species (Coleman and Kruckeberg 1999, Harrison 1999). It is estimated that 10% of California's endemic flora is associated with serpentine patches; this habitat is particularly important because it is more resistant to invasion by introduced species than more fertile soils (Heunneke et al. 1990, Harrison 1997). Harrison (1999) noted that invasion by non-native species increased with calcium levels and decreased with patch size. Less dramatic but similarly important effects may occur on islands of other distinctive substrata, such as limestone and gabbro. Soils with hard pans that develop perched water tables in winter and spring may support unique species tolerant of flooding and desiccation.

Unique habitats can also occur due to biological features. Depending upon the lifespan of the vegetation, these can be ephemeral or semipermanent habitats. According to Sillett and Bailey (2003), large redwood trees are among the "most structurally complex trees on earth," with individual crowns composed of "multiple, reiterated trunks rising from other trunks and branches...indistinguishable from free-standing trees except for their origins within the crown of a larger tree." Sillett and Van Pelt (2000) studied a single old-growth redwood tree in Redwood National Park and found its crown had "148 resprouted trunks arising from the main trunk, other trunks, or branches, with the largest resprout being over 40 m tall. Other habitat elements created by fire or other disturbances (snags, catfaces), as well as canopy deformation caused by pathogens (mistletoe brooms), are probably also importance spatially restricted terrestrial habitats.

Rare Habitat Types: Subterranean

Aside from the more accessible caves, we currently know very little about the subterranean environment and its rare habitats. Soils may be the most biologically diverse environments all park ecosystems. Mesic forests west of the Pacific Northwest often have deep litter layers and may support the highest densities and diversities of soil arthropods

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

anywhere in the world (Moldenke 1999). Moreover, the mix of varied climate and rock types here results in patchy soil regimes, ideal for speciation of subterranean biota.

Below and adjacent to flowing waters, the hyporheic zone has been increasingly recognized as a biologically rich realm (Edwards 1998), supporting communities of invertebrates such as microcrustaceans, oligochaetes, water mites, and early larval forms of stoneflies and may-flies. In addition, they form prime habitat for spawning salmon, due to oxygenated stream water downwelling through redds (Stanford and Ward 1993).

Although locally abundant, caves are rare and highly unique when viewed at a landscape or regional scale. Factors that increase cave biodiversity include many caves in an area, large cave size, and moderate organic input. Cave Archae and bacteria form manganese-rich patinas, cave slime, Mundmilch, and rust. While we know this habitat diversity is important for cave flora and fauna, no systematic study of its rarity has been compiled.

Karst caves, with their distinctively complex mixture or background and accreted rock types are structurally and chemically diverse. Flowing or dripping water may also provide habitat for unique species. The ice caves and lava tubes represent thermal refugia in an otherwise hot, dry environment/macroclimate that is used by a number of species. For example, American pikas found in Lava Beds occur 805 m below the lowest elevation they would be predicted to inhabit, based on extant populations in the adjacent Great Basin (Beever 2002; E. Beever, unpublished analyses). Several ferns occurring in lava tube openings are disjunct from their typical habitats by hundreds of kilometers (Smith et al. 1993). For example, *Dryopteris expansa* populations at Lava Beds are disjunct by many kilometers from within their main range in coastal Humboldt and Del Norte Counties. Bryophytes with a predominantly coastal (*Dendroalsia abietina*) or arctic-alpine distribution (*Anastrophyllum minutum*) have also been discovered in the thermal refugia of lava tube openings (S. L. Jessup, unpublished research). Also, the disjunct arctic-alpine liverwort, *Anastrophyllum minutum*, is only found in deep recesses of talus at the bottom of collapsed lava tubes (S. L. Jessup, unpublished research).

1.3. Rare and Endangered Species

Background

Rare and endangered species are an integral part of an I&M program. They can be influenced by a variety of factors affecting population numbers, including habitat fragmentation, pollution, disease, and climate change. The purposes of this section are to 1) provide a brief background on rarity, 2) discuss patterns of rarity and their implications for inventory and monitoring, 3) explore the general reasons why plants and animals are rare or endangered, 4) examine the threats to rare and endangered species within the KLMN, and 5) provide a list of rare species for the Network.

The evolutionary history of the Klamath region has resulted in a great deal of rarity due endemism (taxa that occur in a specified area). Endemism is best understood among plants. Endemic plants can be classified into recently evolved rare species (i.e., neoendemics) or old species that were once more broadly distributed but have retreated to current distributional ranges (i.e., paleoendemics) (Fiedler 2001). The region is renowned for the presence of many paleoendemics, and it is considered to have played a central role in the vegetation history of the west as a refugium during climatic fluctuations (Whittaker 1961). The Klamath region not only has a rich relictual flora, but it is also rich in neoendmics (Smith and Sawyer 1988). The presence of serpentine and other unusual substrata fosters speciation through the development of ecotypes specialized to the substratum followed by lack of genetic exchange with parent populations (Grant 1981). Neodemism is also fostered by a rich regional flora, many rapidly evolving genera, and cytological factors such as polyploidy (Stebbins and Major 1965).

Other conspicuous taxa tend not to be as geographically restricted. However, global and regional declines in fish stocks, amphibians, and neotropical migratory birds over the last two decades have heightened concerns about populations of these animals in most KLMN parks. Moreover, aquatic species, while mostly not endemic to the Klamath region, are commonly endemic to the Pacific Northwest and threatened due to potential rarity. For example, FEMAT (1993) identified 314 stocks of fish endemic to the Pacific Northwest within the range of the spotted owl. Similarly, FEMAT (1993) found that 13 of 62 amphibians native to the Pacific Northwest are endemic.

Rarity among mammals is generally not a function of local or regional endemism. Collectively, mammals possess a bimodal pattern of rarity, with many relatively common and rare species (Yu and Dobson 2000). When considering rarity in this taxon, orders with large species (in terms of body mass) have a large proportion of rare species (e.g., perissodactyls, carnivores, primates, diprotodonts). Furthermore, approximately 25% of all mammals are listed as threatened by IUCN (Yu and Dobson 2000). Based on number of taxa, rodents and bats should contain the largest numbers of rare species. However, due to sampling biases (e.g., common species of rodents are more often surveyed than rare species, bats have large home ranges and are dependent on roosting structures that are not evenly distributed throughout the landscape) uncertainties are inherent of this claim (Yu and Dobson 2000).

Much less is known about rarity among inconspicuous life forms (fungi, lichens, non-vascular plants, invertebrates, and microbes) (Marcot 1997). The remainder of this document will therefore focus on rarity in relatively conspicuous species.

1.4. Patterns of Rarity and Their Implications for Inventory and Monitoring

Rabinowitz's (1981) seven pattern model of rarity focuses on three main aspects of species population dynamics (Table 1): local population density, the area of the species range, and the number of habitats which the species occupies. We describe how these patterns of rarity would influence potential monitoring of rare species next. Examples of species exhibiting the different types of rarity are in Table 1.

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

Table 2. Seven forms of rarity based on geographic range, habitat specificity and local abundance, with examples from the Klamath Network. From Rabinowitz (1981).

Geographic Range	Large		Small	
Habitat Specificity	Wide Widespread	Narrow Predictable	Wide Unlikely	Narrow Endemic
Large Dominant Local Populations	Common Species	Whitebark Pine *(Pinus albicaulis)* *White pelican (Pelecanus erythrorhynchos)*	Port-Orford cedar *(Chamaecyparis lawsoniana)* Tanoak *(Lithocarpus densifloris)*	California Pitcher plant *(Darlingtonia californica)*
Small, Non-dominant Local Populations	Sparse Species *Clustered Lady's Slipper (Cypripedium fasciculatum)*	Beaked rush *(Rhynchospora alba)*	Gentner's Fritillary (*Fritilaria gentneri*).	Howell's Alkalai grass *(Puccinellia howellii)*

1) Large geographic range, wide habitat specificity, and small non-dominant local populations. Species with this distributional pattern of rarity present few problems for inventory and monitoring. Species will be widespread geographically and present in many habitat types, although they exist in small non-dominant local populations. This non-dominant population status can make inventory and monitoring efforts attainable in a broad sense because habitats containing the species are abundant. Consequently, within broad habitat types, the small populations may be hard to locate because they are non-dominant and can be responding to microclimate factors. Because of this, a moderately high level of sampling effort may be necessary to efficiently inventory and monitor this type of rarity.

2) Large geographic range, narrow habitat specificity, and large dominant local populations. Species that fall within this pattern of rarity should be easily targeted for inventory and monitoring efforts. The key here is to determine what important habitats these species occupy and then to stratify sampling effort in these habitats. As long as stratification is included in sampling design, large dominant local populations of the species should be easy to inventory and monitor without high levels of sampling effort.

3) Large geographic range, narrow habitat specificity, small, non-dominant, local populations. These species may be good candidates for monitoring. Population changes may be compared with those in other geographic regions. Narrow habitat specificity suggests that these species will be sensitive to changes in their environment.

4). Small geographic range, broad habitat specificity, and large dominant local populations. These species will be less abundant in our network than those with wide geographic ranges. Species with a narrow geographic range will be represented in a portion of the network or possible in just a portion of a single park. This narrow geographic range can be determined from existing data on distribution of the species, and monitoring efforts should be efficient within this range due to broad habitat specificity and large dominant local populations.

5) Small geographic range, broad habitat specificity, and small non-dominant local populations. Sampling for species within this fifth pattern of rarity adds another level of difficulty to those species possessing type 4 rarity. Once the species' narrow geographic range is pinpointed, the broad habitat specificity should facilitate monitoring within several habitats so stratification to a single habitat or habitat association is not as important as it is in types with restricted habitat specificity. Problems arise within this pattern because populations are small and non-dominant, thus detection may be impeded within the large number of habitats the species inhabit. Extensive sampling may be necessary within several habitat types to efficiently inventory and monitor type 5 rarity.

6) Narrow geographic range, narrow habitat specificity, and large dominant local populations. Species with this type of rarity may be the second most difficult to efficiently inventory and monitor. Sampling for species with narrow geographic range and habitat specificity, but with large dominant local populations is an issue of pinpointing within the narrow geographic range, the habitat type or association that the species primarily inhabit. Large dominant local populations make this kind of species abundant within their narrow range and habitat specificity. To efficiently document such species there are two important considerations, 1) geographic range must be determined from existing distributions prior to surveys and 2) sampling must be stratified within the appropriate habitats. A particularly noteworthy example of this type of rarity in the Network is Howell's alkali grass (*Puccinellia howellii*). This species has a narrow geographic range and habitat specificity because it is found in just one wetland in the network, but within this wetland the species has large local populations.

7) Small geographic range, narrow habitat specificity, and small non-dominant local populations. This pattern of rarity will cause the most logistic problems for inventory and monitoring. Once geographic range is documented and sampling efforts are stratified within specific habitats, there is still a possibility that small local populations will be overlooked. To efficiently monitor this type of rarity sampling effort may have to be increased. The 3 important considerations to efficiently monitor this type of rarity are as follows: 1) geographic range must be pinpointed prior to surveys, 2) sampling effort must be stratified, and 3) extensive sampling effort may be necessary to efficiently document the species occurrence within stratified habitats. Species that possess this type 7 rarity would be the marbled murrelet (*Brachyramphus marmoratus*) or the Northern spotted owl (*Strix occidentalis caurina*). For example, due to habitat requirements for marbled murrelet including, proximity to coastline, and availability of old growth forest for nesting, the species fits the first two requirements for this type of rarity, narrow geographic range and habitat specificity. Additionally, because the only park in the Klamath network, Redwood, is located along the southern part of the species range we can expect small non-dominant populations.

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

1.5. Anthropogenic Influences on Rarity

There are many reasons why plant and animal species can be threatened or endangered. First and foremost is habitat fragmentation and destruction, which often occurs because of land use changes. Increases in agriculture and urban sprawl, relics of increasing human populations, contribute immensely to land use change. Unfortunately, this is partially out of our control, but further developments in land use planning are imperative if we are to minimize negative effects on plant and animal populations.

Similarly, habitat degradation in the form of pollution contributes to declines in rare and endangered species. Degradation effects (e.g., increases in ozone levels, agricultural runoff, surface water acidification) are not as obvious as fragmentation and destruction because they may not create abrupt changes. Results of degradation require close monitoring to document these small changes before they have had a chance to cause drastic impacts on community composition and health.

Disease is another factor that can lead to species becoming increasingly threatened and endangered. In small isolated populations (created primarily by fragmentation and habitat destruction), the disease effects may be tremendously magnified. Without nearby source populations to recolonize patches where populations have declined because of disease, the habitat may remain unoccupied by the species, increasing rarity. Similarly, stochastic events (e.g., fire, storms) can effect small populations.

Fire management, climatic change, and very specific habitat requirements can all contribute to increased rarity. Overexploitation in terms of historical hunting or harvesting and collection for scientific collections (e.g. herbarium, bird, and mammal collections) can contribute to decreases in population numbers of rare and endangered species. Finally, exotic species (especially those that are considered invasive) can increase rarity among species because invasives produce fierce competition with natives.

Habitat generalist species are more resistant to many of these changes; they can adapt to habitat variability. These species can more efficiently adapt to changing conditions and will be less affected by fragmentation. Habitat generalists can ordinarily be expected to be common and widespread because of their environmental flexibility (Brown 1984).

Several broad influences (e.g., pollution, climate change) affect the status of habitat specialists. Habitat specialists are also more vulnerable to stochastic events, loss of genetic diversity, and inbreeding. Small population size and restricted location (i.e., endemic species) contribute to increased vulnerability to stochastic events and habitat destruction. Furthermore, habitat specialists who by definition have very specific niches, can be dependent other species to maintain viable population numbers. For example, specialist pollinators form mutualistic relationships with the plant species that they pollinate. If the pollinators' populations exhibit declines then in turn the host plant species that is dependent on the pollinator will suffer a decline as well.

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

1.6. General Threats to Rare Species in the Klamath Network

Populations of rare or endangered species will be negatively affected by habitat alteration where fragmentation produces small isolated patches with limited connectivity. Some species may rely on a certain amount of connectivity in the landscape to efficiently breed and maintain their genetic diversity. This may be of concern in the KLMN, where transboundary issues are evident. Much of the KLMN is surrounded by National Forest land, where timber harvest activity may increase fragmentation. Timber harvest operations may facilitate disease spread when pathogens are transported unintentionally by harvesting equipment.

Habitat degradation is a more subtle danger to rare and endangered species. Pollution may reduce habitat quality and decrease plant or animal species populations. If the species of concern is a k-selected species, these effects are magnified because the species is long lived with low reproductive rates (e.g., bats, which generally produce one pup a year and live to around 20 years). Accordingly, these species are slow to respond to environmental change. Moreover, they will be unable to respond to overexploitation in the form of hunting, harvesting, or over-collecting for scientific collections.

Human and/or visitor uses impact the natural environments of our national parks. Visitors may inadvertently or intentionally pollute or degrade rare habitats and subsequently destroy areas crucial to maintaining viable populations of rare and endangered species. For this reason, it is important to identify areas where these types of habitats exist and direct heavy visitor use away from them. Because park visitors may be interested in frequenting areas that contain rare or endangered species, park staff should ensure visitor awareness by interpretive activities and signing.

A variety of amphibian species have declined across large portions of their range throughout the U.S. (Corn 2000) and information on amphibian responses to fire and fuel reduction practices is critically needed (Pilliod et al. 2003). Fellers and Drost (1993) hypothesized that in the southern Cascades, the cessation of cattle grazing and fire suppression has resulted in loss of open meadow habitat which may be one of the factors contributing to the disappearance of Cascade's frog (*Rana cascadae*) from California. To efficiently manage rare and endangered species, evaluating the effects of fire suppression not only on amphibians, but on all taxa present within the Network is necessary.

A variety of fire management actions occur on national parks, such as fire suppression and fuels manipulations. It is not only the absence of fire that can have negative effects on rare and endangered species, but certain fire management approaches (e.g., wet season burning, crushing vegetation) can be a threat to rare and endangered species as well. Exotic grasses invading chaparral can threaten species that are sensitive to repeat burning that occurs more frequently with grass fuel present. Although mechanical thinning or prescription burning may influence an amphibian community, the occurrence of severe wildfire may have even stronger effects (Pilliod et al. 2003). Our Network must strive to understand how all aspects of fire management will affect rare and endangered species, not just the effects of fire suppression on rare and endangered species.

Exotic species, particularly invasive ones, can detrimentally impact rare and endangered species. Invasive exotics may displace rare species through competition (Appendix G). Once species fall victim to this type of competition, portions of habitat formerly occupied by populations may be inaccessible to recolonization events. For these reasons, exotic species can impede efforts to maintain viable populations of rare and endangered species. For example, Port Orford cedar root rot disease caused by the exotic species *Phytophthora lateralis* is damaging cedar trees at an alarming rate. Although not yet considered a rare plant, the cedar may be heading for the same fate as the American chestnut.

1.7. Rare Species in the Klamath Parks and Their Status

The following table (Table 2) lists the rare species of the parks as recognized by NatureServe. NatureServe is a non-profit conservation organization that provides scientific information to help guide effective conservation action. NatureServe and its network of natural heritage programs have been described as the leading source for information about rare and endangered species and threatened ecosystems (http://www.natureserve.org/aboutUs/). Parks in Oregon had their rankings taken from the Oregon Natural Heritage Program (http://oregonstate.edu/ornhic/). Parks in California had their information taken from the California Natural Diversity Database. Conservation status ranks are based on a one to five scale, ranging from critically imperiled (G1) to demonstrably secure (G5). Status is assessed and documented at three distinct geographic scales-global (G), national (N), and state/province (S). The one through five number scale has the following meaning: 1 = critically imperiled, 2 = imperiled, 3 = vulnerable to extirpation or extinction, 4 = apparently secure, 5 = demonstrably widespread, abundant, and secure. Additional qualifiers that may follow these numbers in the table are: X = presumed extinct, H = possibly extinct, U = unrankable, NR = not ranked, Q = questionable taxonomy, C = only in captivity or cultivation, B = breeding, N = nonbreeding, and M = migrant. Detailed descriptions of rankings are provided at http://www.natureserve.org/explorer/ranking.htm. The overall rarity of a species is explained in Table 3, while Table 4 describes the rarity of organisms within California. Lastly, Table 5 contains the national codes for U.S. legal status of a species.

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

Table 2. Rare species in the Klamath Parks and their Global, State, and Federal status.

Crater Lake National Park				
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**
Accipiter gentilis	Goshawk	G5	S3B	6
Arabis suffrutescens var horizontalis	Crater Lake rockcress	G5T1	S1	6
Arnica viscosa	Sticky arnica	G4	S2	
Ascaphus truei	Coastal tailed frog	G4	S3	7
Asyndesmus lewis	Lewis' Woodpecker			
Bassariscus astutus	Ringtail	G5	S3	
Botrychium lanceolatum	triangle moonwort	G5	S3	
Botrychium pumicola	Pumice grapefern	G3	S3	
Bucephala albeola	Bufflehead	G5	S2B,S5N	
Bucephala islandica	Barrow's goldeneye	G5	S3B,S3N	
Carex abrupta	abrupt-beaked sedge	G5	S1	
Carex crawfordii	Crawford's sedge	G5	S1	
Carex integra	smooth beaked sedge	G5	S3	
Carex Whitneyi	Whitney's sedge			
Charina bottae	rubber boa			
Collomia mazama	Mt. Mazama collomia	G3	S3	
Contopus cooperi	Olive-sided Flycatcher	G4	S3B	7
Cryptantha simulans	pine woods cryptantha	G4	SNR	
Dicentra formosa ssp. oregana	Pacific bleeding heart	G5T4	S4	
Empidonax traillii ? See notes**	Little Willow Flycatcher	G5T3T4	S3S4B	
Epilobium palustre	swamp willow-herb	G5	SNR	
Eriognum pyrolifolium var. pyrolifolium	oarleaf buckwheat	G4T4	SNR	
Falco peregrinus anatum	American Peregrine Falcon	G4T3	S2B	
Gulo gulo luteus	Wolverine	G4T3Q	S1?	7
Haliaeetus leucocephalus	Bald Eagle	G4	S4B, S4N	2
Hieracium greenei	Greene's hawkweed	G3G4	SNR	
Hieracium horridum	shaggy hawkweed	G4	SNR	
Lasionycteris noctivagans	Silver-haired bat	G5	S3S4	7
Lutra canadensis	river otter			
Martes americana	American marten	G5	S3S4	
Martes pennanti	fisher	G5	S2	5
Melanerpes lewis	Lewis's Woodpecker	G4	S2S3B	7
Myotis evotis	long-eared myotis	G5	S4	7
Myotis volans	long-legged myotis	G5	S3	7
Myotis yumanensis	Yuma myotis	G5	S3	7
Oreortyx pictus	Mountain Quail	G5	S4	7
Oncorhynchus kisutch	coho salmon	G4T2Q	S2	2
Oncorhynchus mykiss	steelhead/rainbow trout	G5T3Q	S2S3	
Pelecanus erythrorhynchos	American White Pelican	G3	S2B	

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

Table 2. Rare species in the Klamath Parks and their Global, State, and Federal status (continued).

Crater Lake National Park (continued)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status
Picoides albolarvatus	White-headed Woodpecker	G4	S2S3	7
Picoides arcticus	Black-backed Woodpecker	G5	S3	
Picoides tridactylus	Three-toed Woodpecker			
Poa bolanderi	Bolander's bluegrass	G5	SNR	
Rana cascadae	Cascades frog	G3G4	S3	7
Rana pretiosa	spotted frog	G2	S2	5
Ribes inerme var. klamathense	white stem gooseberry	G5T3?	SNR	
Salvelinus confluentus	Bull trout (Klamath River population)	G3T2Q	S2	2
Sayornis nigricans	Black Phoebe			
Sceloporus graciosus graciosus	northern sagebrush lizard	G5T5	S5	7
Sciurus griseus	western gray squirrel	G5	S4	
Sorbus californica	California mountain ash	G5	SNR	
Strix nebulosa	Great Grey Owl	G5	S3	
Strix occidentalis caurina	Northern Spotted Owl	G3T3	S3	2
Taricha granulosa mazamae	Crater Lake newt	G5T1Q	S1	
Torreyochloa erecta	few-flowered mannagrass	G4G5	S3	
Utricularia minor	lesser bladderwort	G5	S2	

Oregon Caves National Monument

Scientific Name	Common Name	Global Rank	State Rank	Federal Status
Accipiter gentilis	Northern Goshawk	G5	S3B	6
Ascaphus truei	tailed frog	G4	S3	6
Contopus cooperi	Olive-sided flycatcher	G4	S3B	6
Corynorhinus townsendii	Townsends's big-eared bat	G4	S2	6
Empidonax traillii brewsteri	Little Willow Flycatcher	G5T3T4	S3S4B	
Lampropeltis zonata	California mountain kingsnake	G4G5	S4	6
Martes pennanti	Pacific fisher	G5	S2	5
Myotis evotis	long-eared myotis	G5	S4	6
Myotis thysanodes	fringed myotis	G4G5	S2	6
Myotis volans	long-legged myotis	G5	S3	6
Myotis yumanensis	Yuma myotis	G5	S3	6
Nebria gebleri siskiyouensis	Siskiyou gazelle beetle	G4G5T4	S4	6
Rana pretiosa	spotted frog	G2	S2	C
Rhyacotriton variegates	southern torrent salamander	G3G4	S3	6
Plethodon elongatus	Del Norte salamander	G4	S3	6
Strix occidentalis	Northern Spotted Owl	G3T3	S3	2

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

Table 2. Rare species in the Klamath Parks and their Global, State, and Federal status (continued).

Lassen Volcanic National Park				
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**
Accipiter gentiles	Northern Goshawk	G5	S3	7
Asplenium septentrionale	northern spleenwort	G4G5	S2.3	7
Campanula scabrella	rough harebell	G4	S3.3	7
Carex lasiocarpa	wooly-fruited sedge	G5	S1.3?	7
Carex limosa	shore sedge	G5	S3?	7
Catostomus micropsl	Modoc sucker	G1	S1	1
Collomia larsenii	talus collomia	G4	S1.2	7
Corydalis caseana caseana	Sierra corydalis			
Draba aureola	golden draba	G4	S1.3	7
Drosera angelica	long-leaf sundew	G5	S2S3	7
Empidinox traillii	Willow Flycatcher	G5	S1S2	7
Erigeron elegantulus	volcanic daisy	G4G5	S3.3	7
Lasionycteris noctivagans	silver-haired bat			
Lycopus uniflorus	northern bugleweed	G5	S3.3	7
Marsilea oligospora	Pacific water-clover			
Myotis thysanodes	fringed myotis	G4G5	S4	7
Myotis yumanensis	Yuma myotis	G5	S4?	7
Myotis evotis	long-eared myotis	G5	S4?	7
Myotis volans	long-legged myotis	G5	S4?	7
Oncorhynchus kisutch	coho salmon	G4	S2?	2
Oncorhynchus mykiss	steelhead/rainbow trout	G5	S2	7
Oncorhynchus tshawytscha	chinook salmon	G5	S1	2
Pelecanus erythrorhynchos	American White Pelican	G3	S1	7
Penstemon cinicola	ash beard-tongue	G4	S3.3	7
Penstemon heterodoxus var. shastensis	Shasta beard-tongue	G5T3	S3.3	7
Phlox muscoides	moss phlox	G4	S2S3	7
Potamogeton praelongus	white-stemmed pondweed	G5	S1S2	7
Rana cascadae	Cascades frog	G3G4	S3	7
Rana pretiosa	spotted frog	G2	S1	5
Rhynchospora alba	white-beaked rush	G5	S3.2	7
Scheuchzeria palustris amer.	American scheuchzeria	G5T5	S1.1	7
Scirpus subterminalis	water bulrush	G4G5	S2S3	7
Silene invisa	short-petalled campion			
Silene suksdorfii	Cascade alpine catchfly	G4	S2.3	7
Smelowskia ovalis congesta	Mt. Lassen smelowskia	G5T1	S1.2	7
Stellaria obtusa	obtuse starwort	G5	S3.3	7
Strix nebulosa	Great Grey Owl	G5	S1	7
Strix occidentalis	California spotted owl	G3T3	S3	7
Trimorpha acris var. debilis	Northern Daisy	G5T4	S2S3	7

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

Table 2. Rare species in the Klamath Parks and their Global, State, and Federal status (continued).

Lava Beds National Monument				
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**
Accipiter cooperii	Cooper's Hawk	G5	S3	7
Antrozous pallidus	pallid bat	G5	S3	7
Corynorhinus townsendii	Townsend's big-eared bat	G4T3T4	S2S3	7
Halioeetus leucocephalus	Bald Eagle	G4	S2	2
Lasionycteris noctivigans	silver-haired bat			
Myotis ciliolabrum	western small-footed myotis	G5	S?	7
Myotis evotis	long-eared myotis	G5	S4?	7
Myotis thysanodes	fringed myotis	G4G5	S4	7
Myotis volans	long-legged myotis	G5	S4?	7
Pelecanus erythrorhynchos	American White Pelican	G3	S1	7
Riparia riparia	Bank Swallow	G5	S2S3	7
Taxidea taxus	American badger	G5	S4	7

Redwood National and State Park				
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**
Abronia umbellata ssp. breviflora	pink sand-verbena	G4G5T2	S2.1	7
Acipenser medirostris	green sturgeon	G3	S1S2	7
Ascaphus truei	tailed frog	G4	S2S3	7
Balaenoptera borealis	sei whale			
Balaenoptera physalus	finback whale			
Boschniakia hookeri	small groundcone	G5	S1S2	7
Brachyramphus marmoratus	Marbled Murrelet	G3G4	S1	2
Branta canadensis leucopareia	Aleutian Canada Goose	G5T3	S2	8
Calamagrostis bolanderi	Bolander's reed grass	G3	S3.2	7
Calamagrostis crassiglumis	Thurber's reed grass	G3Q	S1.2	7
Calamagrostis foliosa	leafy reed grass	G3	S3.2	7
Calystegia atriplicifolia ssp. buttensis	Butte County morning-glory	G5T2	S3.2	7
Caretta caretta	loggerhead turtle			
Castilleja affinis ssp. litoralis	Oregon coast Indian paintbrush	G4G5T4	S2.2	7
Castilleja miniata ssp. elata	Siskiyou Indian paintbrush	G5T3	S2.2	7
Charadrius alexandrinus nivosus	Snowy Plovers	G4T3	S2	2
Chelonia mydas	green turtle			
Cypripedium califonicum	California lady's-slipper	G3	S3.2	7
Dermochelys coriacea	leatherback turtle			
Dicentra formosa ssp. oregana	Oregon bleeding heart	G5T4	S3.2	7
Eleocharis parvula	small spikerush	G5	S3.3	7
Empetrum nigrum ssp. hermaphroditum	black crowberry	G5T5	S2?	7
Erigeron cervinus	Siskiyou daisy	G3	S3.3	

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

Table 2. Rare species in the Klamath Parks and their Global, State, and Federal status (continued).

Redwood National and State Park (continued) **Scientific Name**	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**
Erigeron supplex	supple fleabane	G1	S1.1	7
Eriogonum pendulum	Waldo buckwheat	G4	S2.2	7
Erysimum franciscanum	San Francisco wallflower	G3	S3.2	7
Eucyclogobius newberryi	tidewater goby	G3	S2S3	1
Eumatopias jubatus	Stellar sea lion	G3	S2	2
Falco peregrinus	Peregrine Falcon	G4T3	S2	8
Gilia capitata ssp. pacifica	Pacific gilia	G5T3T4	S?	7
Glehnia littoralis ssp. leiocarpa	American glehnia	G5T5	S3.2	7
Haliaeetus leucocephalus	Bald Eagle	G4	S2	2
Hemizonia congesta ssp. tracyi	Tracy's tarplant	G5T3	S3.3	7
Horkelia sericata	Howell's horkelia	G3G4	S3.3	7
Iliamna latibracteata	California globe mallow	G3	S3.3	7
Iris innominata	Del Norte County iris	G4G5	S3.3	7
Iris tenax ssp. klamathensis	Orleans iris	G4G5T3	S3.3	7
Juncus supiniformis	hair-leaved rush	G5	S2.2?	7
Lathyrus biflorus	two-flowered pea	G1	S1.1	7
Lathyrus delnorticus	Del Norte pea	G4	S3.3	7
Lathyrus japonicus	sand pea	G5	S1.1	7
Lathyrus palustris	marsh pea	G5	S2S3	7
Layia carnosa	beach layia	G1	S1.1	1
Lilium bolanderi	Bolander's lily	G4	S3.2	7
Lilium occidentale	western lily	G1	S1.2	1
Lilium pardalinum ssp. vollmeri	Vollmer's lily	G5T4	S3.3	7
Lilium pardalinum ssp. wigginsii	Wiggins' lily	G4T4	S3.3	7
Lilium washingtonianum ssp. purpurascens	purple-flowered Washington lily	G4T4	S3.3	7
Listera cordata	heart-leaved twayblade	G5	S3.2	7
Lomatium tracyi	Tracy's lomatium	G3	S3.3	7
Lycopodium clavatum	running-pine	G5	S2S3	7
Lycopus uniflorus	northern bugleweed	G5	S3.3	7
Martes pennanti pacifica	Pacific fisher	G5T3T4	S2S3	5
Minuartia howellii	Howell's sandwort	G4	S3.2	7
Moneses uniflora	woodnymph	G5	S3.3	7
Monotropa uniflora	Indian-pipe	G5	S2S3	7
Oenothera wolfii	Wolf's evening-primrose	G1	S1.1	7
Oncorhynchus clarkii clarkii	cutthroat trout	G4T4	S3	7
Oncorhynchus kisutch	coho salmon	G4	S2?	2
Oncorhynchus mykiss	steelhead/rainbow trout	G5	S2	7

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

Table 2. Rare species in the Klamath Parks and their Global, State, and Federal status (continued).

Redwood National and State Park (continued) Scientific Name	Common Name	Global Rank	State Rank	Federal Status
Oncorhynchus tshawytscha	chinook salmon	G5	S1	2
Oxalis suksdorfii	Suksdorf's wood-sorrel	G4	S3.3	7
Pelecanus erythrorhynchos	American White Pelican	G3	S1	7
Pelecanus occidentalis californicus	Brown Pelican	G4T3	S1S2	1
Pinguicula vulgaris ssp. macroceras	horned butterwort	G5T4Q	S3.2	7
Pityopus californicus	California pinefoot	G4G5	S3.2	7
Plethodon elongatus	Del Norte salamander	G3	S3	7
Pleuropogon refractus	nodding semaphore grass	G4	S3.2?	7
Poa piperi	Piper's blue grass	G4	S3.3	7
Pyrrocoma racemosa var. congesta	Del Norte pyrrocoma	G5T4	S2.3	7
Rana aurora daytonii	California red-legged frog	G4T2T3	S2S3	2
Rhyacotriton olympicus	Olympic salamander			
Rhyacotriton variegates	southern torrent salamander	G3G4	S2S3	7
Ribes laxiflorum	trailing black currant	G5	S3.3	7
Riparia riparia	Bank Swallow	G5	S2S3	7
Salix delnortensis	Del Norte willow	G4	S3.3	7
Sanguisorba officinalis	great burnet	G5?	S2.2	7
Sanicula peckiana	Peck's sanicle	G4	S3.3	7
Saxifraga howellii	Howell's saxifrage	G4	S3.3	7
Senecio bolanderi var. bolanderi	seacoast ragwort	G4T4	S1.2	7
Senecio macounii	Siskiyou Mountains ragwort	G5	S3.3	7
Sidalcea malachroides	maple-leaved checkerbloom	G2	S3.2	7
Sidalcea malviflora ssp. patula	Siskiyou checkerbloom	G5T1	S1.1	7
Sterna elegans	elegant tern	G2	S1	7
Strix occidentalis caurina	Northern Spotted Owl	G3T3	S2S3	2
Tauschia glauca	glaucous tauschia	G4	S3.3	7
Thlaspi californicum	Kneeland Prairie pennycress	G1	S1.1	1
Trientalis arctica	arctic starflower	G5	S1.2	7
Vancouveria chrysantha	Siskiyou inside-out-flower	G4	S3.3	7
Veratrum insolitum	Siskiyou false-hellebore	G3	S3.3	7
Viola langsdorfii	Langsdorf's violet	G4	S1.1	7
Viola palustris	marsh violet	G5	S1S2	7
Viola primulifolia ssp. occidentalis	western bog violet	G4T2	S2.2	7

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

Table 2. Rare species in the Klamath Parks and their Global, State, and Federal status (continued).

Whiskeytown National Recreation Area				
Scientific Name	**Common Name**	**Global Rank**	**State Rank**	**Federal Status**
Accipiter cooperii	Cooper's Hawk	G5	S3	7
Accipiter striatus	Sharp-shinned Hawk	G5	S3	7
Allium sanbornii var. sanbornii	Sanborn’s onion	G3T3	S3.2	7
Allium tribracteatum	three-bracted onion	G2	S2.2	7
Arnica venosa	Shasta County arnica	G3	S3.2	7
Atrozous pallidus	pallid bat			
Clarkia mildrediae	Mildred's clarkia	G3T3	S3.3	7
Clarkia virgata	Sierra clarkia	G3	S3.3	7
Clemmys marmorata marmorata	northwestern pond turtle			
Corynorhinus townsendii townsendii	Pacific western big-eared bat	G4T3T4	S2S3	7
Cypripedium fasciculatum	clustered lady’s slipper	G4	S3.2	7
Dendroica petechia brewsteri	Yellow Warbler	G5T3?	S2	7
Eleocharis parvula	small spikerush	G5	S3.3	7
Falco columbarius	Merlin	G5	S3	7
Gavia immer	Common Loon	G5	S1	7
Haliaaeetus leucocephalus	Southern bald eagle	G4	S2	2
Icteria virens	Yellow-breasted Chat	G5	S3	7
Juncus marginatus var marginatus	red-anthered juncus	G5T5	S2S3	7
Larus californicus	California Gull	G5	S2	7
Linanthus rattanii	Rattan’s linanthus			
Martes pennanti pacifica	Pacific fisher	G5T3T4 Q	S2S3	5
Navarretia heterandra	Tehama navarretia	G3	S3.3	7
Onchorynchus mykiss	steelhead trout	G5	S2	7
Oncorhynchus tshawytscha	spring-run chinook salmon	G5T1Q	S1	2
Pandion haliaetus	Osprey	G5	S3	7
Penstemon purpusii	snowmountain beardtongue			
Phalacrocorax auritus	Double-crested Cormorant	G5	S3	7
Puccinellia howellii	Howell's alakali grass	G1	S1.1	7
Rana aurora daytonii	California red-legged frog	G4T2T3	S2S3	2
Rana boylei	foothill yellow-legged frog	G3	S2S3	7
Riparia riparia	Bank Swallow	G5	S2S3	7
Sagittaria sanfordii	Sanford’s arrowhead			
Sedum paradisum	Canyon Creek stonecrop	G1	S1.3	7
Spea hammondii	western spadefoot	G3	S3	7
Strix occidentalis caurina	Northern Spotted Owl	G3T3	S2S3	2
Trillium ovatum ssp. oettingerii	Salmon Mountains wakerobin	G5T3	S3.2	7
Triteleia crocea var. crocea	Trinity Mountain triteleia			

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

Table 3. Global Rank (GRANK) reflects overall condition (rarity and endangerment) of an element throughout its range. Ranks are assigned by the California Natural Diversity Database biology staff following review of all available information.

GRANK	Meaning (at species or Natural Community level)
G1	Less than 6 Element Occurrences (EO) OR less than 1,000 individuals OR less than 2,000 acres
G2	6 - 20 EOs OR 1,000 - 3,000 individuals OR 2,000 - 10,000 acres
G3	21 - 100 EOs OR 3,000 - 10,000 individuals OR 10,000 - 50,000 acres
G4	Apparently secure; this rank is clearly lower than G3 but factors exist to cause some concern; i.e. there is some threat, or somewhat narrow habitat.
G5	Population or stand demonstrably secure to ineradicable due to being commonly found in the world.
GnTn	Subspecies receive a T-rank attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies; where n = 1, 2,3,4,5 as described above.
GH	All sites are historical; the element has not been seen for at least 20 years, but suitable habitat still exists.
GX	All sites are extirpated; this element is extinct in the wild.

Table 4. The State Rank (SRANK) reflects condition (rarity and endangerment) of an element within the State of California. Ranks may be combined to indicate a range, e.g. S1S2.

SRANK	Description
S1	Less than 6 Element Occurrences (EOs) OR less than 1,000 individuals OR less than 2,000 acres:
S1.1	Very threatened
S1.2	Threatened
S1.3	No current threats known
S2	6 - 20 EOs OR 1,000 - 3,000 individuals OR 2,000 - 10,000 acres:
S2.1	Very threatened
S2.2	Threatened
S2.3	No current threats known
S3	21 - 100 EOs OR 3,000 - 10,000 individuals OR 10,000 - 50,000 acres:
S3.1	Very threatened
S3.2	Threatened
S3.3	No current threats known
S4	Apparently secure within California; this rank is clearly lower than S3 but factors exist to cause some concern; i.e. there is some threat, or somewhat narrow habitat.
S5	Demonstrably secure to ineradicable in California. NO THREAT RANK.
SH	All sites as historical; the element has not been seen

Table 5. FEDLIST: Federal Listing Status (FEDCODE): United States legal status under the Federal Endangered Species Act (ESA).

FEDCODE	FEDDESC
1	Federally listed as Endangered
2	Federally listed as Threatened
3	Proposed for federal listing as Endangered
4	Proposed for federal listing as Threatened
5	Candidate for federal listing
6	Species of concern
7	None - no federal status
8	Delisted - previously listed

(See Federal Register for legal definitions of Federal status)

Appendix D. Rare Habitats and Species of the Klamath Network (continued).

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