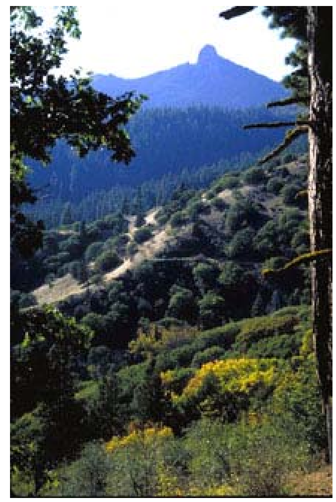
Protecting Objects of Scientific Interest in the Cascade-Siskiyou National Monument:
Status, Threats and Management Recommendations

Compiled and Edited by

Dennis C. Odion
Odion Botanical Consulting and
University of California, Santa Barbara

and

Evan J. Frost
Wildwood Environmental Consulting
Ashland, OR



December 2002

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WWF

Prepared for the World Wildlife Fund
Klamath-Siskiyou Regional Program
Ashland, OR

This project was supported by funds generously provided to the World Wildlife Fund from the Wyss Foundation, Bullitt Foundation, and Wilburforce Foundation

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Introduction

The primary objective of this document is to supply the USDI, Bureau of Land Management (BLM) with outside expertise with regard to managing the Cascade-Siskiyou National Monument (hereafter referred to as "the monument" or "CSNM" by various authors). This expertise is provided by the most knowledgeable independent authorities who have considerable expertise with the monument's unique attributes and biological resources. As explained in this report, the proposed management needs to be ecologically-based, and there is some new information regarding the "Objects of Scientific Interest" for which the monument was designated to protect.

The specific objectives of this document are:

1. To provide a brief overview and state-of-knowledge on selected "Objects of Scientific Interest" (OSI) as identified in the Presidential Proclamation that established the monument (Appendix I);
2. To describe the status and condition of the OSIs in relation to ecological integrity on the monument and surrounding area;
3. To provide management recommendations consistent with protecting and restoring ecological integrity in the monument.
4. Offer evidence from independent researchers.

The Bureau of Land Management has established the National Landscape Conservation System (NLCS) to help protect some of the nation's most remarkable and biologically diverse landscapes. This report is consistent with the mission of this new entity and providing assistance in achieving goals in common.

The management guidelines herein follow directly from the intent of the Presidential Proclamation (Appendix I) and its mandate that preserving the OSIs shall take precedence over any other considerations (i.e. "shall be the dominant reservation"). The biological objects of interest specifically identified include:

- A spectacular variety of rare and beautiful species of plants and animals
- the rich mosaic of grass and shrublands
- Garry and California black oak woodlands
- Juniper scablands
- Mixed conifer and white fir forests
- Wet meadows, and riparian forests
- The exceptional range of fauna
- One of the highest diversities of butterfly species in the United States
- Center of diversity for freshwater snails
- Three endemic fish species
- Important populations of small mammals, reptiles, amphibians and ungulates
- Important winter habitat for deer
- Old-growth habitat crucial to the threatened northern spotted owl

These OSIs occur in an area of unique geology, biology, climate and topography set in the interface of the Cascade, Klamath, and Siskiyou ecoregions, a true "biological crossroads."

In order to ensure the mandate to protect this "rich enclave of natural resources," it is vital that management is ecosystem-based; that is, a balanced approach emphasizing interconnectedness and integrity of all species and communities across the landscape and the processes that have sustained them. Ecological integrity may be succinctly defined as, "A system's wholeness, including presence of all appropriate elements and occurrence of all processes at appropriate rates" (Angermeier and Karr 1994). Indicators of ecological integrity include: 1) maintenance of native species, or lack of species extirpation 2) occurrence of natural processes, and 3) complex biophysical structure resulting from these processes.

We believe that it is necessary for an agency such as BLM to have outside scientific assistance to best assure that the language in the Presidential Proclamation is strictly adhered. To protect OSIs, it is requisite for BLM to have independent scientific support for any management activities, demonstrating consistency with ecological integrity principles, BLM's NLCS program and the mandate set forth in the Proclamation language, i.e. "activities that maintain or enhance the monument's objects of interest shall be permitted." Moreover, this support must necessarily come from experts on the ecology and systematics of the objects of interest. The local experts that contributed to this report should be considered in a scientific capacity for assisting BLM in implementing management approaches for the monument.

The best strategy for maintaining the diverse array of biological objects of interest in the monument would be to provide the same processes and conditions that shaped and sustained the ecosystem over evolutionary time. This is not entirely possible due to lack of understanding and the realities, and, at the present time managing for human safety around homes interspersed in the monument landscape. For example, it is unclear what the monument area will be like once it adjusts to the present climate, which is warmer than most of the last millennia, and which is warming further (Millar and Wolfenden 1999).

Despite these constraints, management can be improved by being more compatible with evolutionary history as best we know. The most significant threats to the ecological integrity of the monument are the accumulation of direct and indirect human disturbances that have occurred and are still occurring, in and immediately adjacent to the monument. Preventing additional human disturbance (and reducing the effects of past disturbance) generally will provide the best approach to maintenance of the objects of scientific interest.

A common theme among the management recommendations included here is that the impacts of proposed treatments, especially those that are unprecedented in the evolutionary history of the flora and fauna, are not adequately considered or understood. Therefore, we applaud the idea of rigorously experimenting with treatments as mentioned in the preferred alternative. However, more specifics and scientific guidance are needed to ensure that experiments are designed, undertaken, and analyzed with sufficient rigor and proper hypothesis testing at the appropriate spatio-temporal scales. This guidance would also be invaluable to applying the results of experiments through the adaptive management process.

Literature Cited

Angermeier, P.L. and J.R. Karr. 1994. Biological integrity versus biological diversity as policy directives. Bioscience 44: 690-697.

Millar, C. I. And W. B. Woolfenden. 1999. The role of climate change in interpreting historical variability. Ecological Applications 9: 1207-1216.

Summary Table of Objects of Scientific Interest in the Cascade-Siskiyou National Monument addressed by authors in this report, with existing threats and recommended management actions for addressing these threats.

Object of Scientific Interest	Existing Threats	Management Recommendations
Rare/endemic plant species (R. Brock)	Habitat degradation from non-native weeds.	Enhance habitats and populations of rare species by containing the spread of invasive weeds and controlling weed populations where feasible. This will require increased restriction of vehicles and livestock grazing, as well as a well-funded weed eradication program. Initial focus should be on key problem areas, including the I-5 corridor.
Rare/unique vegetation types and naturally diverse vegetation mosaic (R. Brock)	Active management activities (e.g. fuel reduction) that disturb vegetation types and patterns. Non-native weeds (see rare/endemic plant species).	Adopt a three-tiered approach to management based on level of available knowledge and risks of adverse impacts: • <u>Ecological knowledge is unavailable</u>: delay management activities until research generates an understanding of community dynamics and ecological function, which can serve as basis for designing treatments. • <u>Ecological knowledge is available, high risk of adverse effects</u>: proceed with management activities cautiously and incrementally, using an adaptive/experimental approach. • <u>Ecological knowledge is available, low risk of adverse effects</u>: carefully implement management activities designed to restore community structure and function in degraded areas. Conduct further study of vegetation dynamics before conducting fuel treatments in the Diversity Management Area, which can inform long-term reintroduction of fire.
Chaparral and shrublands (D. Odion)	Non-native weeds (also see rare/endemic plant species). Overly frequent and out-of-season burning.	Any soil-disturbing activities (including prescribed fire) should be followed by exotic weed contain and control efforts. Apply prescribed fire to shrublands only in cautious, experimental manner. Burning should occur during normal fire season and take into account potential adverse effects of weed invasion, altered community dynamics, and other factors. Consider the unique ecology of shrublands/chaparral – as opposed to grasslands and other vegetation types – when planning and implementing management activities.
Mixed conifer forests (D. DellaSala)	Livestock grazing. Fire suppression. Roads. Mechanical thinning/fuels reduction.	Assess grazing impacts, remove cattle where impacts are documented. Restrict road access during the fire season. Conduct landowner education on appropriate fuel reduction methods for private lands in the wildland interface. Decommission as many non-residential public roads in the monument as possible, including all public land jeep trails. Focus thinning on removal of trees that have established since onset of effective fire suppression (~1950; generally less than 14" dbh). Follow treatments with prescribed fire within the natural fire season and monitor ecological effects.

Object of Scientific Interest	Existing Threats	Management Recommendations
Birds (P. Trail)	Livestock grazing. Roads and their associated impacts. Fire suppression.	Strict control or elimination of grazing. Closure and removal of roads wherever possible. Increase the role of fire in habitat creation and maintenance through careful, incremental introduction of prescribed fire and judicious management of wildfire for resource benefit.
Peregrine falcons (J. Pagel)	Human disturbance from rock climbing and other recreation-related activities.	Restrict human activities during known nesting season around nest sites, using three management zones based on distance from nest. Proposed activities within the three zones shall be scrutinized by a wildlife biologist and designed so as to avoid adverse effects to peregrines.
Butterflies and moths (E. Runquist)	Habitat fragmentation and degradation through the spread of invasive weeds, fire suppression, forest closure, and stand-replacing fire.	Strengthen weed management plan and increase weed contain/control efforts, particularly of yellow star thistle. Avoid disturbance to or loss of important butterfly host plants or key habitat elements. Consult a lepidopterist with intimate knowledge of a targeted area in the design and implementation of any active management treatments, including prescribed burning.
Aquatic habitats and associated fauna (M. Parker)	Stream channelization, impoundment, and redistribution of water for irrigation and livestock watering. Negative effects of domestic livestock on riparian vegetation, bank stability, nutrient loading and erosion. Invasion by non-native species. Effects of roads and road crossings on sediment delivery and stream channel morphology. Potential negative effects of uncharacteristically large, intense wildfire.	Reduce, and where possible, eliminate current adverse impacts to watersheds within the monument, especially the following: • Cessation or curtailment of livestock grazing, particularly in riparian areas and around seeps, springs and other wetlands. Evaluate adverse impacts associated with stock ponds. If occurring, remove these impoundments, especially from active stream channels. • Determine the current distribution and abundance of non-native aquatic and riparian species within the monument. Develop plans for controlling the spread of exotics and reducing/eliminating them where possible. • Inventory existing and former roads within monument watersheds to identify sites where negative impacts are occurring or most likely to occur, and target these sites for restoration (e.g. stabilize hydrologically). • Conduct fire/forest restoration treatments in accordance with ecological principles as described in the fire and forest management section.

Object of Scientific Interest	Existing Threats	Management Recommendations
Aquatic habitats and associated fauna, cont'd. (M. Parker)	Logging and other disturbances on private lands adjacent to/embedded within the CSNM.	• Work with private landowners in/adjacent to the monument to prevent or minimize potential impacts to aquatic systems. Restore riparian and aquatic habitats damaged by past activities.
Fire and forest management (E. Frost and D. Odion)	Increasing likelihood of uncharacteristically severe fire due to past management activities (e.g. logging, fire suppression, grazing) Adverse environmental impacts associated with mechanical fuel reduction treatments. Increasing number of residences and other structures on private lands adjacent to the monument without fire-proofing measures undertaken in home ignition zone.	Develop specific fire/forest restoration plans for the monument based on ten ecological principles: • Develop a fire management plan that minimizes adverse effects of fire suppression and creates defensible space immediately around existing homes and structures. • Plan at the landscape scale. • Prioritize restoration treatments to maximize ecological benefits and minimize risks. • Protect areas with high ecological integrity. • Restore fire as a key ecological process. • Experiment with mechanical treatments that facilitate the reintroduction of fire. • Manage for naturally high levels of heterogeneity. • Implement multiple, conservative treatments. • Integrate restoration projects with species-level conservation goals. • Incorporate research, monitoring and adaptive management as essential elements of restoration efforts.
Landscape connectivity (D. DellaSala)	Habitat fragmentation associated with roads and logging (terrestrial), physical barriers to stream flow, water diversions and introduction of non-native species (aquatic).	Identify, manage for, and (where appropriate) enhance the aquatic and terrestrial connectivity functions of the monument in accordance with a set of ecological principles described in this document.

Vegetation Patterns, Rare Plants and Plant Associations

by Richard Brock [1]

I. Introduction and Overview

The Cascade-Siskiyou National Monument area has long been recognized for its botanical diversity, including occurrences of many species not normally found in the local region. Many of the plant communities are unique and vegetation patterns are unusual and often confusing. Steep elevation gradients, geographic location, highly variable soil depth, and general ruggedness all contribute to the unique features of the monument. There has been, to date, only limited study of the many aspects of the vegetation and flora of the monument. This section outlines a few of the observations to date related to key objects of scientific interest, which include:

- highly concentrated, high quality, representative cross-section of the convergence of several ecoregions;
- natural processes of plant community interaction and migration and species migration;
- high diversity of plant communities;
- endemic rare plant communities;
- remnant native grasslands; and
- critical habitat for several rare and endangered plant species

In addition, the area is known for its many unusual occurrences such as:

- An extraordinarily high concentration of taxa in the genus *Fritillaria*, with five species putting on showy displays each spring in the Upper Dutch Oven Creek Canyon, Slide Creek riparian forest, Colestine Valley moist woodlands and riparian zones and in many patches in the more moist habitat types and at higher elevations, meadow edges.

- Disjunct occurrences of eastern Oregon species such as daggerpod *(Phoenicaulis cheiranthoides*), long-branched phacelia (*Phacelia ramosissima*), Pursh's milk vetch (*Astragalus purshii*) and California Rafinesquia (*Rafinesquia californica*). These species are evidence of plant migration from the east into the eastern Siskiyous.

- Stark rocky slopes with western juniper, bluebunch wheatgrass and many features representative of eastern Oregon.

- High quality remnants of the native oak-grassland ecosystem such as in vicinity of Agate Flat and the Colestine Valley.

- Towering old-growth California black oak and bigleaf maple in the narrow alluvial benches along the major streams.

- Dazzling wildflower displays at high elevations.

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[1] Consulting Botanist, Siskiyou Bio-Survey, Ashland, OR

- Large clonal patches of Oregon white oak that form dense half to one-acre forests in the middle of steep mountain grasslands.

- A diverse, unusual and compact juxtaposition of plant communities that are normally separated by many miles. Within the same 40 acre area, one can find dense stands of mock orange (*Philadelphus lewisii*) adjacent to cool, moist white fir forest with western juniper savanna in openings and California black oak / bigleaf maple woodland, Oregon white oak / mountain mahogany (*Cercocarpus ledifolius*) chaparral, Oregon white oak woodland and ponderosa pine forest – all in close proximity.

II. Key Natural Processes

What we have in the Diversity Emphasis portion of the monument is a wealth of ecological information that we have only barely begun to assess. In ecosystem studies, processes are central elements of research (e.g., mycorrhizal association, succession, and disturbance). In the CSNM, there are several processes that are key to the values for which the monument was created, as described below.

<u>Community-level interactions</u>

One of the most important "Objects of Scientific Interest" in the CSNM is the large set of ecological processes that can be observed when plant communities are juxtaposed in unusual ways. The location, composition and extent of communities such as the Oregon white oak / rosaceous chaparral, grassland or island conifer stands changes over time with such influences as fire, mean temperature and precipitation. During some time periods, conifers have occurred in some of the landscape in which they are currently absent. During other time periods, grasslands may have been larger or smaller than they are today. In the shrub communities, species dominance shifts over time and with slight variations in soil depth, aspect, elevation and probably fire history. One of the key elements shaping the landscape patterns in the monument is soils, or more specifically, the regular occurrence of shallow rocky soils.

One plant community, the Douglas-fir / Oregon white oak association is an excellent example which we can monitor with dramatic results over relatively short time periods. In this community, Oregon white oak is the dominant but there is enough moisture for Douglas-fir to grow, usually in small numbers. If a period of low disturbance and relatively high moisture ensues, Douglas-fir can grow to become a significant overstory tree (often referred to as "invasion" by some land managers). When drought develops, however, these conifers are susceptible to stress-related mortality and often die. This mortality is now commonly seen in these communities. Likewise, fire will often kill the Douglas-fir while oaks will rejuvenate by stump sprouting. Sequential fire, as often occurred historically, can remove Douglas-fir for extended periods of time by removing seedlings and leaving the oaks relatively unaffected. The limited stands of this association (in the Emigrant Creek watershed) in the monument are a valuable resource for studying this process.

In the Scotch Creek Research Natural Area (RNA), there is a series of sites that are valuable for the study of successional processes in mixed community types. In this dry area, there is a mosaic of Oregon white oak / rosaceous shrubland and small patches of dry Douglas-fir forest. There are also stands where each type is relatively distinct. Other sites, however, support the typical rosaceous shrubland species [e.g. serviceberry, (*Amelanchier* spp.), mountain mahogany (*Cercocarpus ledifolius*), and snowberry (*Symphoricarpos* spp.)] and a few elements of the Douglas-fir forest [e.g. western starflower (*Trientalis latifolia*) and baldhip rose (*Rosa gymnocarpa*)] but very few Douglas-fir. There are also intermediate sites where Douglas-fir is developing and, under these small patches, the suite of woodland and chaparral species are found to be decreasing. Some would call this "invasion" by Douglas-fir but on these harsh sites, where Douglas-fir has a competitive disadvantage, it is most interesting to watch these two communities interact. Of course during a period of frequent fires, Douglas-fir would be greatly reduced, but during periods of cooler and or more moist climate, the Douglas-fir community must have been able to thrive on these sites.

Another community with interesting, and relatively unknown, species interactions is the Oregon white oak - ponderosa pine - western juniper type in the Colestine Valley. It has been noted that the tree species have drastically different responses to fire (BLM 2002). Western juniper will not persist in a system with frequent fire while Oregon white oak and Brewer's oak (*Quercus garryana* ssp. *breweri*) sprout back quickly after fire and thus survive well under a frequent fire regime. We have assumed that this area had frequent fire up to 1900 or so and so the question remains; how does western juniper persist in this community?

Of great management and conservation concern is the interaction of the new invader weed species such as star thistle (*Centaurea solstitialis*), medusahead (*Elymus caput-medusae*) and bulbous bluegrass (*Poa bulbosa*) with the native plant communities, and particularly with disturbance. We know that exposed bare soil, such as is created by burning, and livestock grazing are quickly invaded by these species.

Species and community migration

The monument is an excellent place to study the process of plant species migration and plant community migration. These migrations, of course, occur over long spans of time. What we currently have as a resource are residual elements of many ebbs and flows of vegetation over the landscape. Detling (1961) described this process for the wedgeleaf ceanothus (*Ceanothus cuneatus*) chaparral and described the monument area as central in the northerly migration of this community type. He also described the CSNM as the northernmost limit of the true California chaparral region. The east-west migration patterns are much more difficult to interpret.

Individual species interaction and hybridization

The natural process of species development is well represented in many species here. Typical *Quercus garryana* hybridizes with *Quercus garryana* ssp. *breweri* to form short-statured clones that resemble the smaller *breweri* form but with leaf morphology that varies from typical *Q. breweri* to typical *Q. garryana*. Also present are large tree-form individuals typical for *Q. garryana*. Understanding this hybridization will be central to learning how to manage the oak woodland / shrubland, particularly in the southwestern portion of the monument.

III. Plant Communities and Geographic Variation

A key reason for the establishment of the CSNM was the recognition that the monument area is a significant meeting point for many plant communities from adjacent regions. Many individual species are at, or near, the limits of their respective ranges here. In the southern portion of the monument, this meeting and mixing of communities turns into a complex of vegetation that baffles plant community ecologists and will provide research and study opportunities for decades to come.

There have been many interpretations and different classifications of the patterns of plant communities in our region. Likewise, eco-regions, bio-regions and ecological provinces are mapped in different ways by different researchers. Descriptive differences arise as a function of different scales of analysis and different purposes for the assessment. Most often, classification is based on the current dominant species present in existing plant communities or based on the potential dominant species that develop as communities mature. In practice, both of these approaches are necessary for proper analysis.

When mapping vegetation, separate plant communities can be lumped together based on relative similarities and placed in a hierarchical system of "associations" and "series." Inevitably, complexes of two or more types intermingle at the landscape level, and these complexes change over time. Many classifications are limited in geographic scope and types may overlap and be named differently by different researchers. All these factors can lead to some confusion when discussing vegetation patterns, especially in a place as complex as the CSNM.

We currently have adequate descriptive data for most of the conifer forest types in the north half of the monument, but only limited data for the "Diversity Emphasis Area" portion in the southern half of the monument. This is simply due to the long history of timber management in the north half, in contrast to the inaccessibility and steep, broken terrain of the Diversity Emphasis Area.

Over the past 20 years, the point has been made that the monument area is a convergence of bio-regions, with the most frequently named being the Cascade Mountains, Klamath-Siskiyou Mountains, the California Floristic Province and the Great Basin Floristic Province. These very general geographic regional terms offer a simplistic view of some of the influences at work in the monument but the situation is much more complicated. The big picture is that most of southwest Oregon and northwest California exhibit elements of bio-regional mixing. There are many sub-regions and many cross-influences.

The most accurate way to describe the monument is as a highly concentrated, high quality, representative cross-section of a larger region where these various eco-regions converge. A useful representation would be to say that the CSNM contains plant communities which show affinities for five regions or sub-regions; 1) the California Cascade Province, 2) the eastern Siskiyou Mountains, 3) the western Oregon Interior Valleys, 4) the Shasta Valley and 5) the great "Eastside" region which can most locally can be referred to as the Klamath Basin and Modoc Plateau. The floristic influences of each of these sub-regions are described in more detail below.

<u>Klamath Basin and Modoc Plateau</u>

Perhaps the most distinctive influence in the CSNM is from the dry regions of the Klamath Basin and Modoc Plateau to the east. The plant species and communities of this region extend west through the breach of the Cascades created by the Klamath River into the Shasta Valley which is in the rain shadow of the Klamath Mountains. Western juniper and sagebrush dominate significant portions of the Shasta Valley, mixing with communities and species of the interior coast range and Klamath Mountains. CSNM is at the northwest edge of this westward bulge in the Great Basin flora and contains many elements of it.

Scattered throughout the monument, on the more shallow rocky soils, are patches of the western juniper / bunchgrass plant community (Kagan and Caicco 1996) which is common throughout eastern Oregon and the Modoc Plateau. In most areas, the native bunchgrasses have been seriously reduced by livestock grazing, but there are still scattered patches of Idaho fescue

(*Festuca idahoensis*) and bluebunch wheatgrass (*Psuedoregneria spicata*), as well as the characteristic green rabbit brush (*Chrysothamnus viscidiflorus*) and Pursh's milk vetch (*Astragalus purshii*). Sagebrush is not common, however, and fades out altogether toward the western end of the monument. Another element of this region is the small-scattered stands of quaking aspen (*Populus tremuloides*) occasionally found in wetland sites at the higher elevations.

Many of the rocky meadows contain species with eastern affinities, including many that reach the eastern limit of their distribution here. There is even one western larch tree (*Larix occidentalis*; probably planted) and one small stand of Washoe pine (*Pinus washoensis*). Some of the most interesting botanical discoveries during a typical day in the monument come from this eastern flora which often are quite out of place in what is mostly a Cascade and Siskiyou setting.

<u>California Cascades</u>

Most of the conifer forests in the monument are best thought of as a northern bastion of what has been called the Sierra Province (Franklin and Dyrness 1973). This has also been called the Southern Oregon Cascades. It includes forest communities seen as far north as the Rogue-Umpqua Divide and east into the Klamath Basin but best developed in the California Cascades and northern Sierras. Several plant communities are present within this general theme, including the mixed conifer forest, white fir forests and ponderosa pine – incense cedar – California black oak forest association.

The higher elevation forests and those in the Jenny Creek watershed as well as the dry "forest islands" in the "Diversity Emphasis Area" are representative of this region. The lower elevation forests in the Emigrant Creek watershed are more characteristic of the Siskiyou and Cascade foothill Douglas-fir forest types. Kagan and Caicco (1996) call the mixed conifer forest type in this area the "Siskiyou-Sierra mixed conifer forest" and give a geographic range of "western slopes of the southern Cascade Range and the eastern Siskiyou Mountains," thus indicating their distinctive local nature.

Two species common in the northern California Cascade zone but not known further north in Oregon are common in these forests; the shrub form of golden chinquapin (*Chrysolepis sempervirens*) and a delicately flowered woodland star (*Lithophragma campanulata*). There are also many unique characteristics not seen in forests to the north or the south. The key factor for the development of these forests is climate, with dry, warm conditions favoring pine species and mixed forest composition while dry, cool conditions favor white fir (*Abies concolor*) and Shasta red fir (*Abies magnifica* var. *shastensis*).

The vast dry mixed conifer forests in the east portion of the monument (and east to Keno) once held what was considered to be some of the largest pines on the west coast (Foley 1985). These forests were the target of aggressive logging beginning in the 1920's and continuing to the present, though the last two decades have seen liquidation of smaller and smaller trees as timber companies try to recoup investments in a landscape that is slow to recover. If there is any place where this vast forest will regain any of it's past glory, it will be inside the monument where there are still remnants of old growth to remind us of what once was abundant (see mixed conifer section).

One characteristic of these forests is their tendency to remain as dry openings once cut. Commonly this is referred to as "reforestation failure" which is quite frequent and well documented in the southern Oregon Cascades (Minore 1978). The BLM reforestation monitoring records clearly demonstrate the difficulty of re-establishing well-stocked forests in clearcut areas.

A combination of frost, drought stress, gophers from adjacent openings, and deer browse make reforestation problematic. Most commonly, lodgepole pine and ponderosa pine can be grown where there once was a mix of many conifer species. This tendency is testimony to the tenuous and transitional nature of the forests of this area. Variations in moisture and temperature over the centuries have led to shifts in species composition and forest density. Compounding matters, the frequent shallow soil pockets and rock outcrops (characteristic of the monument) create permanent meadow openings leading to a large area of edge, and thus naturally fragmented conditions with high species diversity.

Eastern Siskiyou Mountains

The influence of the Klamath-Siskiyou on the CSNM bio-region is difficult to assess, but paradoxically is probably the most pronounced. The Klamath-Siskiyou region has been a biological reservoir for millions of years, harboring species from the north during ice ages and species from the south during hot, dry periods (Wallace 1983). Some of the species now occupying the southern Oregon Cascades and other areas to the east may have taken refuge in the large "island" now known as the Klamath Province (Whittaker 1961).

It is probable that our landscape would look very different if not for this refugia of the Klamath –Siskiyous. This ancient history, though, is currently difficult to read on the landscape. The Siskiyou region, in itself, is so diverse (DellaSala et al. 1999) that generalizations are not really possible. We do not know if eastern species (i.e. sagebrush, quaking aspen, Pursh's milkvetch, etc.) are recent arrivals to the Siskiyous or long-time residents. Likewise, many of the plant communities of the Siskiyou Mountains contain elements commonly seen either to the north or to the south as well as local endemics (Smith and Sawyer 1988).

We can say, though, that several of the current plant communities in the monument have a relationship with what is known as the eastern Siskiyous. Most notably, these include the Oregon white oak – rosaceous chaparral, the ridgeline meadows (which also contain many eastern species) and the low-elevation Douglas-fir forests, with madrone (*Arbutus menzesii*) and poison oak (*Toxicodendron diversilobum*) found in the Emigrant Creek watershed. Another type of Douglas-fir forest is limited to the eastern Siskiyous and the monument area; this is an undescribed type that is often referred to as the Douglas- fir / serviceberry – tall Oregon grape association.

The monument's riparian forests with bigleaf maple and California black oak are also well-represented in the Siskiyous. These communities themselves are products of the general mixing of species from various regions (characteristic of the Klamath Province more generally) but are locally restricted with solid representation in the eastern Siskiyous. It is very likely that the Pilot Rock, Soda Mountain ridgeline has been central to the migration of several species into and out of the eastern Siskiyous (e.g. *Mimulus nanus*, *Artemesia tridentata*, *Lupinus breweri*), which illustrates the connectivity function of the monument.

Western Oregon Interior Valleys / Cascade Foothills

The Interior Valleys of southern Oregon have long been known for their distinctive plant communities that contain many components of the California flora. The Rogue Valley has its own set of plant communities, characterized by the Oregon white oak woodlands (with poison oak), dry California black oak forest and mixed Douglas-fir / Oregon white oak forests. These vegetation types are well represented in the monument, particularly in the Emigrant Creek watershed. The sclerophyllous chaparral dominated by wedgeleaf ceanothus is also characteristic of both the Rogue and the Shasta Valleys. There are distinct differences between these two chaparral formations, however, with most the monument area representing a transition zone between the two (Detling 1961).

The presence or absence of both poison oak and Pacific madrone are key to understanding the affinities of the various oak woodlands and dry forest types. North of the Rogue-Klamath Divide, these species are fairly common; south of the Divide they disappear with rare exception. Where present, these species indicate a relationship to the Cascade foothills and the eastern Siskiyous. Where absent, the community is more closely aligned with the California Cascade province or the Modoc Plateau – Klamath Basin region.

The lower elevations of the Cascades that lies adjacent to the Rogue Valley / Bear Creek Valley (the "Cascade foothills") support grasslands and dry conifer forests that are also found in the monument. These dry forests are similar to the forests of the eastern Siskiyous, and are often grouped together with them (Atzet et. al. 1996).

Shasta Valley

The Shasta Valley flora is heavily influenced by wedgeleaf ceanothus chaparral, Oregon white oak woodlands (without poison oak) and grasslands as well as the "great western bulge" of the Modoc Plateau and Klamath Basin vegetation formation. The chaparral communities have increased during hot and dry periods, particularly the wedgeleaf chaparral. The Siskiyou Summit area has been a significant barrier to northerly migration, except during very warm periods (Detling 1961). Many species are found south of the Rogue-Klamath Divide that do not occur farther north.

IV. Fine-Grained Vegetation Patterns

In the CSNM, biological diversity is supported on the macro-scale by the convergence of bio-regions that supply the diversity of species to the area. But equally important is the local-scale diversity of habitat types within the monument. Key to this micro-scale diversity is the high frequency of rock outcrops, shallow soil "scablands", and soils with high cobble content. Regular and frequent variation in soil moisture across the landscape contributes greatly to the patchiness in plant communities that we see in the "Diversity Emphasis Area." It also contributes to the species diversity within the mixed conifer zone.

Within a typical landscape, it is common to have several plant communities interacting and forming mosaics across the landscape, responding to variations in soil depth, aspect, moisture availability and elevation. Usually three or four distinct plant communities can be found forming mosaics within a given area. In some landscapes, communities or mosaic types will cover very large areas giving a quality of homogeneity. For example, large areas of mid-elevation conifer forest will exhibit this pattern, as will vast areas of the Great Basin or even serpentine landscapes. The "Diversity Emphasis Area" of the CSNM is just the opposite. Here, patch size is small, mosaics are very complex and community types can be starkly contrasting. Mapping such a mosaic has proven to be extremely difficult and will continue to provide a challenge to plant ecologists for a long time to come.

Patch size is central to diversity. Many small patches of distinct community types will tend to maximize diversity, not only of plant species but also of insect and animal species. The larger the patch size, the less diverse an area becomes. This is not to say that large patches are not important, though. In large patches, more specialized species develop. For instance, large stands of older conifer forest develop rich diversity of saprophytic plants, with species like phantom orchid (*Cephalanthera austinae*), coral root orchids (*Coralloriza* spp.) and myriad fungi.

All else being equal, a landscape with large areas of fine-grained patchiness and equally large areas of stable, late seral vegetation will support the highest levels of biodiversity, and this is exactly what occurs across the CSNM landscape. The key feature driving the community diversity and fine grain pattern in the monument is the variation in soil depth and rock content found across the area. The most abundant soil type in the "Diversity Emphasis Area" is the McMullin-Rock Outcrop Complex, which as its name suggests has an abundance of rock outcrops. The other soils in the area are likewise of varying depth with shallow "skeletal" soil areas common as well as areas with very high cobble content. The skeletal soil areas are also found throughout the northern portion of the monument and further north along the rim of the Cascades as far north as Grizzly Peak, north of Ashland. These shallow soils provide habitat for numerous plants, including the many east-side species and Siskiyou meadow species. The skeletal soils are also where we find the western juniper / bunchgrass communities.

Within the large Oregon white oak / rosaceous shrubland areas, we find this variation in soil depth strongly influences patterns of species dominance (Brock and Callagan, 1999). For example, rocky areas tend to support more birchleaf mountain mahogany (*Cercocarpus betuloides*), silktassle (*Garrya fremontia*), Klamath plum (*Prunus subcordata*) and serviceberry (*Amelanchier alnifolia*), while deeper soil areas tend to support more ocean spray (*Holodiscus discolor*), tall snowberry (*Symphoricarpos albus*), bitter cherry (*Prunus emarginata*) and oak. Also within the shrubland mosaic is a fine-grained patchiness of rock outcrops and openings of various kinds. Riparian zones add further to the complex by supporting conifers, maple, and dense stands of mock orange (*Philadelphus lewisii*) as well as diverse herb layers.

The effect of this fine-grained pattern of plant community distribution in the "Diversity Emphasis Area" is that there are ample niches for most, if not all, of the plant species currently represented. In other words, the current condition already provides a diversity / range of habitat types similar to what is referred to as "age classes" in the DEIS. This fact has management implications in that there is no urgent need to actively modify plant community structure to ensure maintenance of species that often become "shaded out" as overstory canopies develop. These species currently are stable within the existing mosaic because canopy gaps and areas of sparse canopy are currently abundant.

Within the areas of the monument that support conifer forest, the situation is different. In these areas, the fine-grained patchiness generated by shallow soil "lenses" and rock outcrops create permanent meadow and oak woodland openings leading to a large area of edge and thus naturally fragmented forest with high species diversity. Adding to the natural fragmentation is the checkerboard of private clearcuts (many unsuccessfully reforested). Within these areas of the monument, it is essential to minimize further fragmentation and encourage development of large blocks of late-seral forest.

V. Rare or Unique Plant Communities

The heavy clay soils (Montmorillonite clay) found in the Colestine-Pilot Rock area and the Agate Flat area support a unique set of plant communities that occur only here and in a limited area of the Shasta and Scott River Valleys. These were first described 40 years ago as "potential white oak – ponderosa pine-juniper" (Detling 1961). In the *Plant Communities of Oregon* (Kagan and Caicco 1996), the area is described as Oregon white oak – ponderosa pine – western juniper / wedgeleaf ceanothus, a "globally imperiled" plant community. A high frequency of openings occurs due to the many rocky surface outcrops and patches of very cobbly soil. There is a natural diversity of habitat niches. In the various shallow soil areas, western juniper grows and escapes fire damage due to the low fire intensity in these spots. Juniper trees occur sometimes singly, sometimes in open patches and sometimes develop into small groves. California black oak grows in the more moist areas.

In openings, three rare local clay-endemic plant species are found; Detling's microseris (*Microseris laciniata* ssp. *detlingii*), Ashland thistle (*Cirsium ciliolatum*) and Greene's Mariposa Lily (*Calochortus greenii*), as well as a diversity of "eastside" species of hawksbeard (*Crepis modocensis*, *C. bakeri*, *C. monticola*). The grass and herb layers within this mosaic range from weedy (in open areas) to native with large areas of excellent native fescue grassland.

At higher elevations, the wedgeleaf ceanothus drops out and is replaced by Klamath plum (*Prunus subcordata*) and serviceberry. Detling described these areas as "scrubby oak". E.L.Greene, a well-known botanist in the 1880's described the type simply as "oak thicket". Either description indicates that these upper slope oak woodlands / shrublands naturally have a low-stature and not the typical large tree oak woodlands that we normally see in the Rogue and Shasta Valleys.

A key element of these plant communities is Brewer's oak (*Quercus garryana* ssp. *breweri*), a shrubby species similar to the typical Oregon white oak (*Q. garryana*) that occurs through northern California and into the southern edge of Oregon. In the monument, Brewer's oak is co-dominant over large areas of clay soils, forming large, dense clonal stands six to fifteen feet high interspersed with variable-sized grassy openings. The taller Oregon white oak is also present forming mixed stands; in fact, these two species form a hybrid complex in this area. The Brewer's oak is top-killed in fire and quickly resprouts but is slow growing so tends to not encroach into open areas.

In one of the many apparent mixings going on in the CSNM, there appears to be a hybridization of Brewer's oak and regular Oregon white oak. The former is currently considered a subspecies of the latter but the taxonomy continues to be an active debate. The typical Brewer's oak of the Klamath-Siskiyou Mountains is a tightly compact plant with very short leaves and petioles. The typical Oregon white oak has very large leaves and significantly larger petioles. But in the CSNM both occur in hybrid / modified form. In other words, there are stands of plain white oak that have leaf dimensions and general tree stature smaller and more shrubby than normal, but still larger than typical for the Brewer's oak; likewise with the variation in the Brewer's oak. Both general varieties exist as do hybrids. Thus, the slopes in the east Colestine Valley and Hutton Creek are a mosaic of genetic types ranging between these two types. It may be hard to tell whether a given oak of young age is a "treeform" oak or a "shrubform" oak. Thus, it will be very difficult to design a "treatment" which would sustain both.

<u>Oregon white oak / rosaceous shrublands</u>

Large areas of the "Diversity Emphasis Area" are covered with a mosaic of shrublands which have collectively been called "Rosaceous chaparral" but is more accurately referred to as Oregon white oak / rosaceous chaparral or "shrublands." The difference reflects the current understanding that oak is a major component of nearly all of these shrub-dominated areas. This plant community is regionally endemic, occurring in the eastern Siskiyous and along these south-facing ridges of the Klamath River Ridges sub-region. The large formations in the monument are the best and largest representations of this community.

Native perennial grasslands

One of the important "Objects of Scientific Interest" in the CSNM is the remnant native grasslands. The keyword here is "remnant." During the decades between 1850 and 1940, nearly all of the grasslands in the Rogue and Shasta Valleys were systematically denuded by uncontrolled grazing of sheep and cattle. The lush perennial Idaho fescue (*Festuca idahoensis*), and other species of fescue, bluebunch wheatgrass and junegrass (*Koelaria macrantha*) were replaced by an army of weedy species of brome (*Bromus diandrus*, *B. hordaceous*), medusahead, star thistle, bulbous bluegrass and other annuals. Topsoil was washed away (and continues to be lost) as the perennial-grass root systems that held it in place were lost. As a result many species of plants and invertebrates, no doubt, were lost from these ecosystems.

Today high quality perennial grasslands now are very rare in our region. There are small patches in the Applegate Valley and weak mixed annual / perennial patches in the Shady Cove-Butte Falls area. But the best remnant grasslands by far are in the "Klamath Ridge" sub-region of the CSNM, particularly in two areas, the Colestine-Pilot Rock area and the Agate Flat-Oregon Gulch area. Other good quality stands can be found in the Scotch Creek RNA and in open areas in the Dutch Oven Creek watershed.

It is not clear why the native perennial grasses were able to hang on in the Klamath Ridges of the CSNM. The steep, dry slopes in Scotch Creek and Dutch Oven Creek were remote and presumably difficult for some animals to graze, but there are many steep difficult slopes in the region that were thoroughly stripped of perennial grasses. George Wright (1954), in his memoirs, indicates that the grasslands deteriorated significantly between 1900 and 1956. While we do not have a good record of the regional destruction of the grasslands, we can speculate that most of the grasslands were seriously degraded before 1900. Therefore we can guess that perhaps intensive grazing did not start on these steep inaccessible Klamath Ridges of the CSNM until after most of the more accessible, lower elevation grasslands were depleted. The Colestine-Pilot Rock and the Agate Flat-Oregon Gulch areas are more difficult to understand. Both of these areas have gentle slopes and relatively good access. Both of these areas also have significant amounts of the deep, heavy montmorillonite clay soils. These sticky soils may have discouraged the year-round grazing that occurred elsewhere.

There are two types of perennial grass communities; the Oregon white oak / savanna and the much more rare open grassland. There are also large areas with mixed perennial / annual grasslands which are much more intact than the mixed grasslands found elsewhere. The oak / savanna is by far the most common in the CSNM. There are several three to five acre patches of nearly pure Idaho fescue and Roemer's fescue (*Festuca roemeri*) under dense canopies of Oregon white oak with occasional ponderosa pine. This is the "Pine-Oak / Fescue" community that once was prevalent on all the interior valley edges and foothills of the region.

More commonly we see individual large white oaks with a solid cover of fescue directly underneath the canopy. Openings are almost always converted to weedy non-native species. The contrast between the weedy open ground and the native perennial cover under the oaks is striking as well as unexplained. It may be that the oak canopy has provided shade to conserve soil moisture, or that the annual species cannot compete in shaded conditions, or perhaps that grazing animals prefer the grass that grows away from the tannin-producing oaks. Whatever the case, it is clear that these oaks are protecting a valuable botanical resource.

The much more rare open grassland type is found in several places, usually on rocky ground. Remnant grasslands on deep clay soils such as in the Colestine and Agate Flat areas are extremely valuable. These sites often have bluebunch wheatgrass and prairie junegrass as well as

Idaho fescue. Often these sites are in small openings surrounded by dense shrubs or in areas far from water. These areas all have some of the annual species present but they are dominated by perennials (up to 40% cover), which allows us to see what all of the grasslands in our region once looked like. Outside of the Illinois Valley serpentine soils, these grasslands are nearly extinct. There are only a handful of half- to one-acre patches in all of southwest Oregon outside of the CSNM. For both of these perennial grassland types, there has not yet been sufficient inventory to direct protection and management activities. It is probable that some type of low-intensity fire will be appropriate.

VI. Rare Plant Species

There are currently identified 30 species of plants and three species of fungi in the monument classified as "Special Status Species" by the BLM. Four other species have historical collections from the monument but are considered to be extirpated in Oregon. Some of these are rare or endangered throughout their range. A number of others are considered rare in Oregon but are more common in California (northern edge of their range).

Two areas of the monument are especially significant for their abundance of botanical rarities. The Colestine-Pilot Rock area contains over 120 rare plant sites including large, very important populations of four very rare local endemics. The Agate Flat-Jenny Creek area is also outstanding for its rare plant populations, particularly Greene's mariposa lily. There are five general patterns of rarity that are useful for considering the plant species in the monument. Some species can be listed in more than one pattern, and are here placed in the most relevant pattern (see the BLM's Draft EIS, Volume One for further discussion of these).

<u>Pattern 1: Local endemics associated with specific habitats.</u>

Montmorillonite clay soils. A unique habitat feature that is often overlooked is the extremely dense shrink-swell clay soils (called "Montmorillonite clay") that occur in the Colestine and Hutton Creek Valleys and in the Agate Flat area. These soils prove difficult for many plants due to limitations in nutrient and moisture availability. The problem is different than the often-discussed nutrient imbalance of the ultramafic soils of the Klamath-Siskiyou Mountains. These clay soils hold adequate moisture and nutrients, but due to the very fine soil particle size, they continue to hold nutrients rather than releasing them in useable form for plants. In the heavy montmorillonite clay soils are four species which are local endemics, as follows:

> *Calochortus greenei*. Greene's Mariposa Lily occurs only in the region between the monument and the Little Shasta River 40 miles to the southeast. It was probably abundant throughout the northern Shasta Valley before intensive year-round livestock grazing wiped it out. Now two population centers are left to maintain the species; a large, dense population in the upper reaches of the Little Shasta River and the many small populations (approximately 90) scattered through the monument. Thus, the monument is a critical refuge. This elegant flower occurs in the Agate Flat-Jenny Creek area and the Colestine-Hutton Creek area and blooms in early July.
>
> *Cirsium ciliolatum*. The Ashland thistle occurs in the area between the Klamath River and Little Butte Creek (west of Medford) in the narrow band of heavy clay soils on the

west slopes of the Cascades. Less than 100 populations are known throughout its range. Most of these are in the monument in the Colestine Valley / Pilot Rock area.

Microseris laciniata ssp. *detlingii*. This is a small plant that would be overlooked by most people except during the flowering season (June), when it puts up a showy yellow dandelion-type flower. It is highly adept at dealing with the restrictions of the clay soils; a long snake-like taproot penetrates the dense soil and the plant stores moisture in leaves that are much more succulent than normal for the genus. The largest populations of this species are found in the monument in the Colestine-Hutton Creek area. A few are also found in the Agate Flat area. It ranges north to the vicinity of Shady Cove, but remains restricted to the heavy clay soils.

Ranunculus austro-oreganus. Southern Oregon buttercup shares the same range as the Ashland thistle and Detling's microseris. With this species, however, the monument populations represent only a small portion of the overall number of plants.

Vernal pools / wetlands. One of the more interesting habitat features occurs in the east portion of the monument in Agate Flat and along the terrace above Jenny Creek and in the large flats east of Lincoln. These mounded prairie or "biscuit scabland" formations have an impermeable hardpan just below the surface and so hold water in "vernal pools" during the winter and into the spring. These pool areas and associated open rocky wetlands support a whole set of interesting species. Two of these are quite rare:

Plagiobothrys figuratus ssp. *corallicarpus*. Coral seeded popcorn flower is a very rare local endemic with a large population in the monument near Lincoln. There are also several populations near Grants Pass and in the Sam's Valley area north of Medford.

Limnanthes floccosa ssp. *bellingeriana*. Bellinger's meadow foam is restricted to vernal wetland habitat and ranges from the Butte Falls area south into California in Shasta County. There are eight populations inside the monument.

Mixed conifer forests. The cool, relatively dry conifer forests in the monument supports a local endemic green flowered wild ginger, *Asarum wagneri*. The populations in the monument (around Chinquapin Mountain) represent the southern limit of the species range. It is found as far north as Diamond Lake.

<u>Pattern 2: Regional endemics that are remnants of the pre-grazing era.</u>

<u>Fritillaria gentneri</u>. Gentner's fritillary is a Federally Endangered member of the lily family that occurs at approximately 80 sites in the Rogue and Applegate Valleys, and on the south slopes of the monument. There are 22 known sites in the monument, making this the second largest concentration (the Jacksonville area is the largest) and a critical area for the recovery of the species. There are two large populations in Dutch Oven Creek, two large populations southwest of Pilot Rock and several small populations in between. It's preferred habitats are ecotones (edges) with conifer forest, dense Brewer's oak thickets and riparian forest. Like other *Fritillaria* species, this plant flowers erratically, making population estimates difficult to establish.

In leaf, *F. gentneri* looks just like the other two species in this genus that are common in the monument; it is only recognizable in flower. This necessitates multiple-year surveys to determine presence or absence. It is likely that this species was once much more common throughout it's range before intensive grazing. One note; there is no evidence to indicate that Gentner's fritillary is being affected in any negative way by fire suppression in the monument. In fact, dense thickets act as deterrents to browsing by deer, rabbits and cattle and so actually may help the species.

Other *Fritillaria* species. The monument has a remarkably high density of the more common fritillary species including red bells (*Fritillaria recurva*) and mission bells *Fritillaria affinis* as well as the more rare yellow bells (*Fritillaria pudica*) and Siskiyou fritillary (*Fritillaria glauca*). In some places there are patches of flowering plants numbering in the hundreds. This high density in itself is a rare occurrence and possible represents what other areas of our region supported before grazing wiped out most populations of species in this family.

Poa rhizomata. Timber bluegrass occurs in the California Klamath Mountains and into Oregon as far north as the Dead Indian Memorial Road. In the monument, it has been found in the Hutton Creek valley. Very little is known about this species with only a few sites currently documented. It is very likely that grazing has reduced its abundance.

<u>Pattern 3: Species that are at the northern limit of their range.</u>

Astragalus californicus. California milkvetch was once thought to be extinct in Oregon but has been relocated in two areas in the monument; in the Scotch Creek RNA and in the Colestine Valley. It is a fairly large perennial that grows in open grasslands and so is vulnerable to grazing and competition from yellow star thistle and medusahead grass. It ranges form here to Shasta County, California.

Astragalus gambellianus. Gambel's milkvetch is a small annual species which is common in the central California region but in Oregon is found at only a very few sites in the monument and in the Bear Creek Valley near Ashland.

Carex serratodens. Saw-tooth sedge is fairly common in California and rare in Oregon (less than 20 known populations). There is one known population in the monument (Scotch Creek).

Delphineum nudicaule. Red larkspur is common through the Coast range and California Cascades but quite rare in Oregon. In the monument it is known from one large and very impressive population in lower Hutton creek.

Hackelia bella. This is a species of the California Klamath Mountains which also occurs in the Hyatt Lake-Chinquapin Mountain area. It has a dense inflorescence of showy white flowers that open in June. This is one species that possibly could have been transported here by humans (or their livestock) because it is an easily spread species which appears to be increasing in abundance in the disturbed areas around Hyatt Lake

Isopyrum stipitatum. This is another species that is very common in California but considered rare in Oregon. In Oregon we have been finding it with increasing regularity in the Rogue and Applegate Valleys, where it is known to be a good indicator of relatively light grazing disturbance history. In the monument it is quite common.

Lathyrus lanzwertii var. *tracyi*. This small white-flowered pea is common in the California Klamath Mountains and Coast Range but known in Oregon only from the monument and north to the Indian Memorial Road. It occurs in moist ridgeline forest and moist oak-mountain mahogany chaparral.

Nemacladus capillaris. This species is common in California but known from only a handful of sites in Oregon, including a few in the monument at Oregon Gulch and Scotch Creek.

Rafinesquia californica. This is a showy though short-lived, white-petaled sunflower plant in the sunflower family that grows in the rocky grasslands. It is a California species that extends a little farther west into the Applegate Valley.

Solanum parishii. Nightshade is common in California but known from only 30 sites in Oregon, including one in Scotch Creek RNA.

In addition there are four species that were collected in the monument area prior to 1940, which may still be present in the monument but have not been seen in recent years:

- *Brodiaea californica*, collected once at Agate Flat.
- *Allium peninsulare*, collected once at the Greensprings summit.
- *Mirabilis greenei*. This is a beautiful perennial that was collected from "Oregon" in the 1800's and currently known to occur 500 feet south of the State Line near Scotch Creek. It ranges from the border to the vicinity of Redding.
- *Triteleia ixioides* var. *anilina*. This yellow-flowered member of the lily family was collected once "near Siskiyou Summit".

<u>Pattern 4: Northern California / Southern Oregon endemics.</u>

There are many species that are found only in the northern California / southern Oregon region. Some of these are rare enough to warrant special consideration.

Balsamorhiza hookeri var. *lanata*. Wooly balsamroot is found only in the Shasta and Scott Valleys with one population at Agate Flat. It is considered potentially threatened throughout its range.

Fritillaria glauca. The Siskiyou fritillary is found mostly in the Klamath-Siskiyou region, and mostly on serpentine soils. It is found in the monument at a few locations on bare rocky areas on the high ridges. These populations represent the easternmost limit of this species' range.

Hieracium greenei. Greene's hawksweed is found in northern California and in Oregon as far north as Roseburg. One population occurs in the monument.

Iliamna bakeri. This species occurs in the Modoc Plateau and Klamath Basin regions where it is very rare. It also occurs at five sites in the monument: on Keene Creek Ridge, Chinquapin Mountain and near Pilot Rock.

Monardella glauca. Coyote mint has several varieties, one of which is common east of the Cascades and into the Modoc Plateau and is present around Chinquapin Mountain.

Perideridia howellii. Howell's false caraway is known from northern California and southwest Oregon. It is abundant along open streams in portions of the monument.

Ribes inerme var. *klamathense*. The Klamath gooseberry occurs in northern California with a few known populations in Oregon. It is abundant along the Klamath River with a few populations along streams in the monument. It is often heavily browsed by caterpillars and may be providing an important butterfly food source.

Pattern 5: Species that are widespread but rare across most of their range.

Cypripedium montanum. Mountain lady slipper orchid is being found with increasing frequency in the monument with several of the populations quite large and very impressive when the flowers are open in June. It is seen mostly in the moist areas of the white oak-mountain mahogany rosaceous chaparral.

Cypripedium fasciculatum. Clustered lady slipper orchid occurs rarely in the monument. In our region the highest concentration of this species is to the west in the Siskiyou Mountains.

Carex capitata. This sedge is known from only a few locations in Oregon, all east of the Cascades. One site is known in the monument at a fen on Chinquapin Mountain.

Carex interior. This sedge is widely distributed but quite rare in Oregon. It has been found in the monument at Parsnip Lakes.

VII. Management Recommendations

The first thing to consider in developing a management strategy for the monument is that there are many vegetation types here that we do not know much about. Applying strategies such as prescribed burning to some of these could have unexpected detrimental effects. A reasonable approach would be to consider three different categories or strata:

1.) Prohibit management activities in poorly studied and rare communities. There are many plant communities that we know very little about such as the white oak / roasaceous shrublands or the Oregon white oak -- Brewers oak -- western juniper type. In these communities, we clearly need to develop research that will lead to an understanding of community dynamics and ecological functioning. We should not be planning modifications in these types until a much better understanding is developed. Further, these communities are currently supporting very significant endangered and rare plant species such as *Fritillaria gentneri*. Enhancement of these species should be given top priority.

2.) Proceed with carefully designed activities in plant communities with fairly good understanding of ecological dynamics but where risks are high. There are some plant communities that we have a fairly good understanding of but are at high risk of unintentional adverse effects such as the Rogue Valley Oregon white oak woodland or the wedgeleaf ceanothus / annual grass chaparral. These types can easily be invaded by yellow star thistle. The white oak woodlands often support healthy populations of Idaho fescue and other native grass species that appear to depend on the tree canopies for competitive advantage against the invasive weed species. We can probably proceed with activities that are carefully designed to avoid the known potential adverse effects, such as small patch clearing in the interior of wedgeleaf ceanothus stands.

3.) Proceed with careful, ecologically-based management activities in those community types – particularly the mixed conifer forests, dry Douglas-fir forests and open grasslands – that we understand fairly well and therefore have a relatively low risk of unintentional adverse impacts. In these types we can, at least in some areas, safely proceed with restorative management activities, such as thinning some of the small trees from below the canopy and application of prescribed fire.

<u>Weed containment and control</u>

Yellow star thistle is the biggest threat to many of the most important plant communities in the "Diversity Management Area". Control and reduction of this species should be given top priority. This includes restriction of vehicles and livestock grazing, as well as a well-funded program of eradication. Endangered remnant perennial grasslands need top priority for protection from weed invasion. Some of these sites are currently being threatened by star thistle and medusahead invasion.

The Interstate 5 corridor through the monument is a very dangerous source of weed invasion and migration. Active restoration and stabilization needs to be pursued to reduce the amount of bare soil available for weed establishment. This corridor is currently a source for significant sediment into Cottonwood Creek. The area should be seen as an opportunity to showcase landscape restoration with native vegetation.

<u>Fuel treatments</u>

The current mosaic condition in much of the "Diversity Emphasis Area" already meets many or most of the goals for patchiness. Further study of vegetation patterns needs to be conducted before any fuels modification or creation of early-seral vegetation is pursued. There appears to be an erroneous assumption that some species are being threatened by development of shrub canopies. Observations on the ground indicate that the current mosaic is very diverse, with niches for all species already existing. Those species that require fire for germination will have no problem waiting for the well-planned reestablishment of seasonally appropriate prescribed management or natural fire at some point in the future, but we should not proceed hastily on the presumed assumption that there is an immediate need for fire at the current time.

The fuels model as it is currently designed is incomplete and is generating flawed fire hazard designations in the monument landscape. Specifically, there is no place in the model to modify the hazard rating relative to patchiness, and in particular rock outcrops and openings. The draft proposal is to simplistically treat all areas with high hazard rating within a certain distance of northern spotted owl habitat. This includes areas of white oak woodland and shrubland that are in very patchy configuration on the landscape. The presence of rocky openings and patchy vegetation distribution will greatly modify fire behavior and significantly reduce hazard at many of these sites. Further, there appears to be no analysis of the fire hazard in the actual owl habitat that is being targeted for protection. Many of the forest stands, particularly in the drier forest types, have fuel profiles that will allow for fire to move through at low intensity. These need to be identified and withdrawn from the aggressive fuels modification proposal.

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Mixed Conifer Forests, with an Emphasis on Late-Successional / Old-Growth Conditions

by Dominick A. DellaSala [1]

I. Ecological Importance and Status

Franklin and Dyrness (1973) list four different forest vegetation zones characteristic of southwest Oregon: (1) mixed-evergreen forests (Siskiyous); (2) mixed-conifer (southern Cascade Range); (3) *Abies concolor* (mid-montane); and (4) *Abies magnifica* var. *shastensis* (upper montane). Of these, the Cascade-Siskiyou National Monument is predominately within the mixed-conifer zone, transitioning to stands dominated by white fir (*Abies concolor)* at the upper elevations (e.g., around Pilot Rock).

Mixed conifer forests (MCFs) are generally characterized by two or more of the following tree species: Douglas-fir (*Pseudotsuga menziesii*), incense cedar (*Calocedrus decurrens*), sugar pine (*Pinus lambertiana*), white fir, and ponderosa pine (*P. ponderosa*) (Franklin and Dyrness 1973). Although considerable variation exists in fire regimes geographically, periodic, low- and mixed-severity fires have historically shaped the structure and composition of these forests throughout their range (Franklin and Dyrness 1973, DellaSala et al. 1998).

The MCFs of the monument are typical of the vegetation type as described by Franklin and Dyrness (1973), which are a northern extension of the montane forests of the Sierra Nevada in California. In the monument, considerable variability exists within the mixed conifer zone. Ponderosa pine and sugar pine occur as scattered individuals more prevalent in the southern portion of monument and the adjoining Horseshoe Wildlife Area, where they blend with oak woodlands and roasaceous chaparral.

Recent observations of pine-dominated forests in the adjoining Horseshoe Wildlife Area reveal isolated pockets of Washoe pine (*Pinus washoensis*), which may be a genetically distinct population (F. Callahan pers. communication). This species has also been observed in the monument near Chinquapin Mountain. White fir tends to be more dominant in MCFs at higher elevations and in older forests, where it is most commonly associated with closed-canopy conditions. Fire regimes in these areas tend to be less frequent and higher intensity than at lower elevations.

Fire return intervals in the monument's MCFs likely ranged from 5-75 years under a low- and mixed-severity regime, as influenced by both lightning and Native Americans (USDI BLM 2002, p. 100; see also fire regimes and fire management section in this document). A small portion (3%) of the monument, high-elevation white fir, burned less frequently and at higher intensities (USDI BLM 2002, p. 100). In general, the combined effect of fires produced a shifting landscape mosaic of mostly multi-aged stands across the landscape, with each patch exhibiting different tree densities, ages and species (Frost and Sweeney 2000).

The majority (>87%) of forests in the monument are mixed conifer forests, ranging in elevation from 762 m to 1,280 m (2,500 – 4,200 ft; USDI BLM 2000 p.47, USDI BLM 2002, p. 78 – also see connectivity section of this report). MCFs are prevalent in many areas, ranging from the lower elevations around Emigrant Creek to higher elevations on the crest of the Soda Mountain/Pilot Rock ridgeline, where they transition to forests dominated by white fir. Pockets

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[1] Program Director, World Wildlife Fund, Klamath-Siskiyou Regional Program, Ashland, OR.

of drier MCFs occur on shallow soils and relatively xeric (south- and west-facing slopes) sites where *Arctostaphylos* spp. and *Ceanothus* spp. dominate the understory. These shrub species are especially prevalent in previously logged areas in upper elevations (e.g., along the PCT near Porcupine Gap); conifer regeneration has proven problematic even under shelterwood logging systems due to moisture stress, pocket gophers, shallow soils, high elevations and steep slopes (Minore 1978).

MCFs provide habitat for numerous forest-dwelling species (e.g. see avifauna section, Table 1). Bird species of particular conservation concern (having federal or BLM status, USDI BLM 2000 pp. 70-77) that utilize mature and old-growth mixed conifer forests include the following:

northern spotted owl (*Strix occidentalis caurina*)	federally threatened
bald eagle (*Haliaeetus leucocephalus*)	federally threatened
golden eagle (*Aquila chrysaetos*)	BLM sensitive species
northern sawwhet owl (*Aegolius acadicus*)	BLM assessment species
flammulated owl (*Otus flammeolus*)	BLM assessment species
great gray owl (*Strix nebulosa*)	BLM sensitive species
peregrine falcon (*Falco peregrinus*)	previously federally endangered
northern goshawk.(*Accipiter gentilis*)	BLM sensitive species
white-headed woodpecker (*Dendrocopos albolarvatus*)	BLM assessment species
black-backed woodpecker (*Picoides arcticus*)	BLM assessment species
northern three-toed woodpecker (*P. tridactylus*)	BLM assessment species
pileated woodpecker (*D. pileatus*)	BLM assessment species
pygmy nuthatch (*Sitta pygmaea)*	ROD species

Twenty-one pair of spotted owls have been reported using the monument's mature and old-growth forests (17 inside the Jenny Creek LSR, 4 outside this LSR – USDI BLM 2000 p. 72).

While little work has been done on forest-dwelling mammals in the monument, recent surveys on Mt. Ashland report Pacific fisher (*Martes pennanti pacifica* – BLM assessment species) (photo records, track identifications, Eugene Wier – Southern Oregon University) and wolverine (*Gulo gulo*) is possible given the location of den sites near Mt. McLoughlin and the extensive home range of this species. Moreover, lynx (*Lynx canadensis*) is suspected to occur along the eastern slopes of the southern Cascade Range and the monument is within the historic range of this species as well. Other mammal species that have special management emphasis utilizing mature/old-growth MCFs include:

black bear (*Ursus americanus*)	species of special interest
cougar (*Felis concolor*)	species of special interest
black-tailed deer (*Odocoileus hemionus*)	BLM special emphasis species
Roosevelt elk (*Cervus elaphus*)	BLM special emphasis species
American marten (*Martes americana*)	BLM assessment species
red tree vole (*Arborimus longicaudus*)	Survey and Manage species

MCFs also likely provide suitable conditions (down wood, cool, moist forests) for six mollusks of special status (USDI BLM 2000 p. 80). While this is noteworthy, mollusks have been poorly surveyed throughout the monument and the limited work to date has revealed potential type localities and yet to be identified species that indicate the area has much greater value for mollusks than indicated by the BLM. The monument has been identified as a "hot spot" of mollusk endemism (T. Frest, pers. communication). Moreover, western pond turtle (*Clemmys marmorata* – BLM sensitive species) and tailed frog (*Ascaphus truei* – BLM assessment species) may find suitable habitat in wetland habitats within the monument's MCFs.

Seventeen rare plants, lichens, and fungi also occur in MCFs in the monument (see USDI BLM 2002 p. 93, 96, and vegetation section in this document), including:

green-flowered ginger (*Asarum wagneri*)	range restricted – BLM sensitive
clustered lady's-slipper (*Cypripedium fasciulatum*)	Survey and Manage, BLM sensitive
mountain lady slipper (*Cypripedium montanum*)	Survey and Manage, BLM sensitive
Baker's globemallow (*Iliamna bakeri*)	range restricted
dwarf isopyrum (*Isopyrum stipitatum*)	range restricted
pale monardella (*Monardella glauca*)	one location in the monument
Howell's false-caraway (*Perideridia howellii*)	regional endemic
common nemacladus (*Nemacladus capillaries*)	few sites in the monument
common pithya (*Pithya vulgaris*)	rare fungus
Miller's cup fungus (*Plectania milleri*)	rare endemic fungus
Bondarzew's polypore (*Bondarzewia montana*)	Survey and Manage, BLM sensitive
Bondarzewia mesenterica	Survey and Manage fungus
Dendriscocaulon intricatulum	Survey and Manage lichen
Gyromitra esculenta	Survey and Manage fungus
Gyromitra montana	Survey and Manage fungus
Tremiscus helvelloides	Survey and Manage fungus
Sarcosphaera coronia	Survey and Manage fungus

Given the rarity of late-successional/old-growth forests on both public and private lands throughout the Pacific Northwest and their importance to numerous species of conservation concern (e.g., USDA Forest Service 1993), remaining mature and old-growth forests should be elevated in importance by the BLM and, based on the proclamation language, they should receive special management attention as an Object of Scientific Interest that BLM is mandated to maintain. Further, given the extensive cutting of old-growth forests on private lands, the monument plays a strategic role in maintaining old-growth forest functions and connectivity for numerous species associated with this vegetation/habitat type.

II. Threats

Primary threats to late-successional/old-growth forest within and surrounding the monument are many, including:

- Extensive livestock grazing has likely altered fuels and vegetative structure, replacing fire tolerant forest-grassland species with combustible woody plants (see Belsky and Blumenthal 1997 for review of cattle-related changes to fuels and fire behavior).
- Fire suppression has shifted the historic pattern of low- and mixed-severity fire to exclude fire, which has led to an increase in understory fuels and shifts in forest species composition (see DellaSala et al.1998 for similar examples). Since fire has been excluded

for several decades, future fires may be expected to burn more intensely and have more severe effects on the biota.

- Extensive past logging has fragmented and diminished the connectivity function of the monument. This trend is exacerbated by logging of forests on private lands that are interspersed within and adjacent to monument lands (see connectivity section, this document).
- High road densities (470 miles of roads, USDI BLM 2002) that contribute to forest fragmentation, elevated probability of human-caused fire ignitions, soil erosion and mass wasting events and water quality problems.
- Spread of invasive exotic species.

Each of these factors has contributed individually and cumulatively to the impairment of ecological integrity, threatening the functions of late-successional/old-growth forests within and adjacent to the monument. These threats and their potential impacts are discussed in more detail below.

<u>Livestock grazing</u>

Based on a literature review completed by the Conservation Biology Institute, grazing has adversely impacted BLM rangelands and other vegetation types across the western U.S. (see www.consbio.org). According to the BLM's own calculations, over 68% of its rangelands are in unsatisfactory condition from overgrazing, and this has led to the decline of native plant communities. Additionally, grazing has been cited as a significant factor in the decline of 76 species listed as or considered for listing under the Endangered Species Act (according to Wilcove et al.1998, most listings are the result of livestock grazing and habitat destruction).

There are few, if any areas in the monument that have not been altered by livestock grazing. Essentially all forests, grasslands, oak woodlands, riparian areas, and shrublands show significant impacts from grazing, including MCFs. In the monument, noxious weeds like yellow star thistle (*Centaurea solstitialis*), Canada thistle (*Cirsium arvense*) and medusahead (*Taeniatherum caput-medusa*) are replacing native grasses. Grazing facilitates a shift towards non-natives by disturbing the soil surface (thereby creating favorable establishment sites) and removing competing native plants. Grazing impacts related to both MCFs and other vegetation types in the monument can be summarized as follows:

- Spread of invasive exotics and loss of native plant communities – livestock may also impact MCFs by altering native plant community composition and exacerbating soil compaction problems.
- Impairment of ecosystem processes (fire) – because livestock selectively graze on forbs and grasses they can shift the composition of forest understory vegetation (Belsky and Blumenthal 1997). This is of particular concern in fire-adapted forests such as those in the monument. Extensive grazing in the monument has contributed to a shift in understory species from grasses and forbs that carry low-intensity fires to less palatable but more combustible woody plants and weeds. These effects can be seen in MCFs as well as other forest (riparian, oak woodland) and non-forest (chaparral) vegetation types throughout the monument.

Fire suppression

Forests in the monument, as is the case for many relatively dry forests in southern Oregon, have experienced decades of fire suppression that, along with removal of large fire resistant trees, has increased the probability of high-intensity fires in areas that were historically characterized by a relatively frequent, low- and mixed-severity fire. According to the BLM, however, it was not until the 1950's that fire suppression became effective, largely due to an increase in suppression forces and improved fire-fighting technology (see USDI BLM 2002, p. 101). Suppression-related vegetation changes are largely correlated with this time period, which should serve as key reference point for designing projects aimed at restoring more appropriate forest conditions.

Over the last 50 years, MCFs in the monument have experienced many of the changes that have created elevated fire hazard levels elsewhere in the western U.S., including:

- accumulation of understory fuels in some places (e.g., urban-wildlands interface, plantations on private lands) especially increased densities of small trees (e.g. fire intolerant/shade tolerant white fir) that have established since ~1950.
- replacement of more fire resistant large-diameter trees – removed by past "high-grade" logging of large Douglas-fir, sugar pine and ponderosa pine – by small diameter, fire intolerant/shade-tolerant species;
- construction of an extensive road network that contributes to increased fire ignition probability from accidental or arson-related fires;
- livestock grazing; and
- construction of homes and other structures within the wildland fuel complex.

Roads

The scientific literature on road impacts makes a compelling case for decommissioning and obliterating roads in the monument to maintain ecological integrity and reduce the risk of fire. Roads inflict numerous impacts on their immediate physical environment (see special issue of *Conservation Biology* 2000 and the connectivity chapter of this report), but more important, roads fragment natural ecosystems and provide access leading to subsequent human disturbances from logging, mining, grazing, introduction of invasive exotics, and dispersed residential development (Forman 2000, Strittholt and DellaSala 2001, Heilman et al. 2002). Roads, deforestation, and fragmentation are intimately related.

The adverse impacts of roads to MCFs within the monument have been related to: (1) spread of invasive exotics; (2) cumulative ignition probability of fire (due to greater access and chance of arson or accidental human-caused fires); (3) soil compaction and related damages from ORVs (especially along jeep trails); and (4) alteration of ecosystem processes particularly hydrology (the numerous roads in the monument have altered hydrology – this is prevalent on Soda Mountain Road just past the fire lookout turn off). In particular, the Schoheim jeep trail is of major concern since access into this area could pin fire fighters down should a fire begin at low elevation and move upslope. This road should be obliterated and fire fighting directed at suppression forces when fires are burning out of control or let burn policy under controlled conditions.

Commercial logging

MCFs have been cumulatively impacted by decades of logging and related road construction within and adjacent to the monument. According to the BLM, 83 percent of the mature-old-growth forests within the monument have been entered for timber harvest (i.e., high grade logging) and six percent has been clearcut (USDI BLM 2002, p. 75). This corresponds to the level of fragmentation documented by researchers (see connectivity section). The combined effects of these activities have been a simplification of stand and landscape structure, in turn contributing to the loss of biodiversity (especially when viewed within the context of a surrounding landscape) and the homogenization of fuels. Thus, remaining late-successional/old-growth forests play a vital role in connectivity both within (through the LSRs) and adjacent to the monument (especially the adjoining Ashland LSR to the west and similar designations northeast of the monument – see connectivity section).

Mechanical thinning / fuels reduction

The BLM's DEIS for the monument advocates widespread use of silvicultural treatments (of which thinning is the most widely proposed harvest-based fuels reduction method) to reduce fuel loads and tree stocking levels, and thereby decrease the probability of large, intense fires. However, the efficacy of thinning as a tool for fire hazard reduction at the landscape scale is controversial, largely unsubstantiated, and fundamentally experimental in nature, thereby requiring caution, particularly when applied across large landscapes or areas of high ecological value (FEMAT 1993, Henjum et al. 1994, DellaSala et al. 1995, SNEP 1996, USDA Forest Service 2000, DellaSala and Frost 2001).

There have been only a few empirical studies that have tested the relationship between thinning or fuels treatment and fire behavior on even a limited basis. In spite of hypothesized benefits, these studies, as well as anecdotal information and analysis of recent fires, suggest that thinning treatments have highly variable results. In some instances, thinning treatments intended to reduce fire hazard appear to have the opposite effect (Huff et al. 1995, van Wagtendonk 1996, Weatherspoon 1996). Such treatments may reduce fuel loads, but they also allow more solar radiation and wind to reach the forest floor. The net effect is usually reduced fuel moisture and increased combustibility (Countryman 1955, Agee 1997).

Second, mechanical treatments fail to mimic the numerous ecological effects of fire, including those associated with soil heating, nutrient cycling, and altering community structure (DellaSala et al. 1995, Chang 1996, Weatherspoon and Skinner, in press). In fact, according to the SNEP (1996), "although silvicultural treatments can mimic the effects of fire on structural patterns of woody vegetation, virtually no data exist on their ability to mimic the ecological functions of natural fire." Silvicultural treatments can create patterns of woody vegetation that appear similar to those that fire would create, but the consequences for nutrient cycling, hydrology, seed scarification, non-woody vegetation response, plant diversity, disease and insect infestation, and genetic diversity are almost unknown."

Third, although our current understanding of the ecological effects of thinning is incomplete, available evidence indicates that these operations, even when carefully conducted, can result in numerous adverse environmental impacts, including:

- damage to soil integrity through increased erosion, compaction, and loss of litter layer (Harvey et al. 1994, Meurisse and Geist 1994);

- increased mortality of residual trees due to pathogens and mechanical damage to boles and roots (Hagle and Schmitz 1993, Filip 1994);
- creation of sediment that may eventually be delivered to streams (Beschta 1978, Grant and Wolff 1991);
- increased levels of fine fuels and near-term fire hazard (Fahnestock 1968, Wilson and Dell 1971, Huff et al. 1995, Weatherspoon 1996);
- dependence on roads, which result in numerous adverse effects (Henjum et al. 1994, Megahan et al. 1994);
- reduced habitat quality for sensitive species associated with cool, moist microsites or closed canopy forests (USDA Forest Service 1993); and.
- effects of pile or broadcast burning of slash in contact with the soil surface. Prolonged smoldering combustion of woody fuels in contact with the soil will result in high mortality on soil-stored seed and spore banks (e.g. Bently and Fenner 1958, Odion and Davis 2000).

These downsides to mechanical treatments should be of particular concern in context of managing the monument, where ecological values are especially high and sustaining/restoring ecological integrity is the primary management objective.

Given the potential for adverse impacts from thinning, many scientists recommend limiting thinning to previously managed stands already degraded by fire suppression and past logging (Henjum et al. 1994, Perry 1995, DellaSala et al.1995, Beschta et al. 1995, McKelvey et al. 1996, Hann et al. 1997, Franklin et al. 1997). Moreover, in cases where thinning can be justified on ecological grounds, thinning should target smaller trees that have encroached since fire suppression became effective (see below).

III. Management Recommendations

Given the unique role that MCFs play in landscape connectivity of the monument and the importance of late-successional/old-growth forests to biodiversity conservation in general, this forest type needs to receive special status as an Object of Scientific Interest. Therefore, only management that contributes to the maintenance or enhancement of MCF functions and ecosystem integrity should be permitted in these forests. The primary factors responsible for threats to MCFs (as described above) need to be addressed in a manner consistent with the status and importance of this forest type in the monument and the relevant proclamation language. While general recommendations are described below, some forest types require careful thinning not only for reduction of hazardous fuels but for the retention of important wildlife habitat features. The following is a discussion of some approaches for setting criteria useful in addressing wildlife habitat needs within the context of hazardous fuels management in MCFs.

In general, indices of forest structure related to tree size, foliage height diversity, canopy gaps, coarse woody debris, and standing dead trees (especially large ones) have been correlated with high levels of forest biodiversity. Many birds (particularly cavity nesting species) and mammals find denning and nesting habitat in the larger trees (dead and alive) and downed wood within the forest. The following are examples from the literature regarding structural characteristics of importance to wildlife in coniferous forests useful in developing retention prescriptions:

- Live trees - DellaSala et al. (1998) developed management prescriptions for a MCF (254 ha, 635 ac) just east of the monument (Bear Valley National Wildlife Refuge, near Keno, OR; elevation 1400 to 1700 m is higher than the monument but historic fire regimes are similar) that is experiencing elevated risk of severe fire as a result of past fire suppression and high-grading of large trees. Based on communal roosting requirements of wintering bald eagles (*Haliaeetus leucocephalus*) and increased density of small trees in the understory, they recommended limiting thinning to trees <35 cm (14 in) dbh. In general, large trees (≥35 cm, and especially >50 cm, 20 in dbh) of all conifer species played a key role in this MCF for roosting eagles; large trees were also beneficial to a suite of other late-successional species.

- Snags – the potential use of a snag by wildlife depends on its diameter, height, and decay class (see Neitro et al. 1985). Large snags (≥50 cm, 20 inch dbh) generally have a greater "longevity" than smaller snags and receive disproportionately high levels of wildlife utilization. Cavity nesting species such as pileated woodpeckers (*Dryocopus pileatus*) require dead trees that are at least 38 cm (16 in) at the point where the cavity is excavated, which generally is at least 9.5 m (31 ft) above the ground (Bull 1975). Other species utilize smaller snags, including downy woodpecker (*Dendrocopus pubescens*, 11 in, 27.5 cm dbh), red-breasted sapsucker (*Sphyrapicus ruber*) and hairy woodpecker (*D. villosus*, 37.5 + cm, 15 + in dbh), and northern flicker (*Colaptes auratus*, 42.5 cm, 17 in dbh).

- Coarse-woody debris (CWD)– dead and down woody material plays numerous important functions in forest ecosystems related to nutrient cycling, soil moisture retention, soil stabilization, nitrogen fixation (e.g. by providing microhabitat for N-fixing bacteria), fire, and wildlife habitat (Thomas et al. 1979 for review). As was true for snags, size and decay class are key indicators of wildlife utilization. As a log decomposes, the plant and micro-faunal community surrounding it undergo successional changes key to forest ecosystem dynamics, forest regeneration, and ecosystem health. Moreover, downed wood is a source of flammable material, however, size also matters with respect to fire behavior with fine materials (twigs and needles) primarily involved in fire spread and large materials involved in fire intensity and burn duration (Maser et al. 1979).

While CWD retention standards need to be adjusted for site specificity, in general, Maser et al. (1979) recommends retaining at least 5 uncharred class 1 or 2 logs per hectare (two/acre; decay class is a function of decomposition stage with smaller numbers indicative of recently fallen trees and larger numbers indicative of advanced decomposition on a scale of 1-5), and the retention of all class 3-5 (advanced decay) stages. For maximum utilization, they recommend retaining logs at least 30-43 cm (12-17 inches) in diameter at the large end and 6 m (20 ft) or more in length. In this fashion, fuels reduction should concentrate on removal of understory fuels that contribute largely to the rate of fire spread while providing for important wildlife habitat structure.

Based on the above general guidelines, we recommend the following management activities for MCFs in the monument:

- Declare late-successional/old-growth mixed conifer forests within the monument as an Object of Scientific Interest in need of special management consistent with maintenance of ecological integrity and biological diversity.
- Document grazing impacts and remove cattle as a contributor to increased fuel loadings (i.e., through their role in transforming understory plant composition and structure).
- Identify and protect specific areas essential to the connectivity functions and elevate the role that late-successional/old-growth forests play in the monument (see connectivity discussion – intact patches of MCF should be treated as core reserves where management is limited to maintenance of ecological integrity).
- Focus thinning in stands where fire suppression has resulted in encroachment of small, shade-tolerant trees by thinning from below the canopy to reduce fuel ladders and reducing surface fuels through carefully planned and implemented prescribed burns. Many stands in the northern part of the monument appear to exhibit high fire hazard ratings because of past logging or location within the urban-wildlands interface.
- Retain medium and large trees as wildlife structure – generally thinning should focus on trees <17" dbh since trees larger than this size play a disproportionately important role as wildlife habitat, contribute less to hazardous fuels than small trees and fuel ladders, and are the next cohort of trees that over time will replace mature trees that die from natural causes. These size class requirements should correspond to the period of effective fire suppression in the monument (post 1950), depending on stand conditions and specific growth rates. Stand prescriptions for thinning should be reduced from a 20" dbh maximum under the preferred alternative (USDI BLM 2002, p. 209) to a 17" dbh maximum that corresponds more closely with the wildlife literature above. Forests subjected to thinning should be interspersed with unthinned areas (variable spaced thinnings and tree clumpings) at both stand and landscape levels to provide for structure and fuel discontinuity.
- Retain large snags (>17" dbh, and a range of decay classes) and sufficient density of logs (adjust the preferred alternative based on above literature review or provide further documentation), focusing on removing fine fuels and ladder fuels for fuels reduction.
- Follow understory thinnings with prescribed fire and monitoring. Burn prescriptions should minimize flame lengths and damage to the roots of mature trees.
- Restore young regenerating stands and plantations by thinning small trees (most pre-commercially) to accelerate development of late-successional forest characteristics. Decommission as many non-residential public roads in the monument as possible (i.e., select Alternative D for road obliteration), including all public land jeep trails (roads/jeep trails are currently the area's biggest overall source of non-commodity, present-and-potential environmental degradation – refer to the 6/98 McCullah/Salix "Schoheim Jeep Trail Hydrology Report", the 5/97 Thiebes/ODFW "…obliterate the Schoheim" letter in BLM files, and EPA's concerns on OHV impacts identified in their letter to Tom Sensing on June 16, 2000).
- Limit road access during fire season.
- Conduct landowner education on appropriate methods for creating defensible space on private lands in the interface zone (Cohen 2000, also see fire management section).
- Replant young forests previously logged with a mixture of pines (especially sugar pine) and other conifers appropriate to the site to facilitate restoration of mixed conifer forest conditions.

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Chaparral and Other Shrub-dominated Vegetation

by Dennis C. Odion [1]

I. Shrubland Vegetation Types

The shrub vegetation of the Cascade-Siskiyou National Monument is unique in many respects. The two main shrubland types found in this area – either dominated by one or more species in the Rosaceae family (i.e. rosaceous) or wedgeleaf ceanothus (*Ceanothus cuneatus*), have generally been described as forms of chaparral. However, they differ from the typical form of this vegetation, which is widespread across southwestern North America. The shrubland type referred to as rosaceous chaparral is composed of deciduous species with relatively soft leaves and lacking obvious drou[1]ght adaptation. True chaparral is defined as a dense, evergreen sclerophyll vegetation (Keeley 2000). Sclerophyllous species have tough, leathery leaves, an adaptation shaped evolutionarily by summer drought.

Unlike typical chaparral, rosaceous chaparral also appears to differ functionally by not being a crown-fire dependent vegetation type. Sampson (1944) reported a four-fold increase in germination rates for western chokecherry (*Prunus virginiana*) when seeds were heated to ~105^{o}C, but germination also occurred without fire effects, unlike many chaparral species. Thus, the term rosaceous chaparral can be misleading. The dense nature of the shrubs/small trees, with interlocking crowns, resembles typical chaparral architecturally, but in other respects this is a functionally different vegetation with a highly restricted distribution.

Conversely, the second form of chaparral in the monument, wedgeleaf *Ceanothus* chaparral, will likely support higher fire severity than the rosaceous shrubland. However, in the monument, the *Ceanothus* chaparral often grows with the shrubs spaced sufficiently far apart that the crowns are not interlocking. This is a vegetation structure suggestive of Great Basin shrublands, where inter-shrub spaces were formerly occupied by perennial grasses (now mostly cheatgrass, *Bromus tectorum*). In addition, the *C. cuneatus* stands in the monument exhibit an uneven-aged demographic structure. This is atypical among non-sprouting chaparral shrubs, including *C. cuneatus* farther south in California.

Apparently, germination and establishment of *C. cuneatus* occurs in the absence of fire at the north end of this species' range. In most of its range, like other non-sprouting chaparral shrubs, this shrub grows as even-aged cohorts dating back to their establishment the first rainy season after the most recent fire. Strong physical dormancy imposed by a very hard seed coat ensures that seeds rarely germinate at other times. Conditions for seedling growth in the typically dense stands prevent any seedlings, if they do appear, from establishing. Thus, this chaparral is also functionally different from the typical form.

It is possible that the semi-Mediterranean climate and/or a different fire regime selected for different germination behavior in *C. cuneatus* toward the northern end of its range, such as the monument area. In particular, the apparently lower fuel loading in *Ceanothus* chaparral will likely produce less soil heating than occurs with fire in typical chaparral, which is notorious for high severity fire and soil heating (Borchert and Odion 1995). Seed coats of *C. cuneatus* near the northern end of its range may be more easily cracked by heat, or by physical processes in the

[1] Plant Ecologist, Odion Botanical Consulting, Ashland, OR and Marine Science Institute, University of California, Santa Barbara, CA.

soil. This may occur among a subset of seed produced, as chaparral plants are known to produce polymorphic seed, where some remains dormant until fire and some can germinate more readily. Whatever the mechanism(s), germination in the absence of fire reduces the size of the dormant seed bank that can germinate after fire.

II. Potential Threats to Shrubland Vegetation

Elsewhere in chaparral, as well as in other shrublands worldwide, non-sprouting shrubs such as *C. cuneatus* are threatened by overly frequent fire (Odion and Tyler 2002, Russell-Smith et al. 2002). This is because fire-free periods have shortened as a result of anthropogenic burning and invasion of exotic species that increase the combustibility of the shrublands when they are regenerating from fire. Without sufficient time to replenish seed banks, non-sprouters can be eliminated by too short of fire free periods. In chaparral, annual grasses now often invade following fire, allowing for early reburns which have been found to replace the shrub vegetation with annual grassland as described below (Zedler et al. 1983).

Research on a number of non-sprouting shrubs in chaparral has documented risk due to fire-free periods that are too short, but there is no evidence of a risk due to senescene in the absence of fire among species that have been studied (Zedler 1995, Keeley 2000, Odion and Tyler, 2002). The commonly accepted premise that chaparral becomes decadent with long fire-free periods has been shown to be generally false, and referred to as the "myth of stand senescence" in a recent review on chaparral (Keeley 2000), although forage available to deer may decrease if a greater proportion is beyond their reach. Moreover, fuel loading has not been found to be reliably predicted by stand age (Payson and Cohen 1990). Fire has been shown to burn readily through chaparral of any age class, at least if hot dry winds occur (Moritz, in press). And, mature chaparral is resistant to invasion by exotic species.

Considering these factors, Keeley (2002) pointed out that prescribed burning does not provide any resource benefit, is risky, and he recommended against it. We concur with this conclusion for the chaparral of the monument, despite its differences. The wedgeleaf *Ceanothus* chaparral in particular may be prone to invasion by yellow star thistle and annual grasses. If these establish in the absence of fire in gaps in the shrub canopy, their seeds may survive fire due to relatively low soil heating (Odion and Davis 2000), allowing especially rapid colonization of stands. Any burning that does occur, intentional or not, *must* be followed by exotic species control efforts such as spot spraying for yellow star thistle and other thistles using Transline. Control of annual grass invasion may be impossible. While the draft management plan preferred alternative proposes burning chaparral, in part to improve winter deer forage, no information is provided demonstrating that forage is decreasing. A more prudent approach is to maintain existing stands rather than risk losing them entirely.

Another problem with prescribed burning in chaparral concerns timing. Research has shown that moistening seed of chaparral plants that are not hard-seeded (i.e. species other than *Ceanothus* and most legumes) causes them to completely lose their heat tolerance (Sweeney 1956, Parker and Roger 1987). These seeds take up moisture seasonally, and as they dry out in summer, they become tolerant of high levels of heating. Seeds are likely to be especially vulnerable to burning after soils have been moistened in fall, but before fuel moisture has risen appreciably, because considerable heat could still be generated by fire at this time.

Burning under these types of conditions is likely to produce unnaturally high seed mortality and result in artificially low seedling emergence (Parker and Roger 1988). This would have adverse, long-term impacts in stands lacking resprouting species. On the other hand, if soils are really wet at the time of fire, and fireline intensity is relatively low, little soil heating will occur (DeBano et al. 1979). In this situation, hard-seeded species may not receive sufficient heat shock to germinate, resulting in a similar impact scenario. It is unclear which other species would be cued to germinate.

Out of season burning in areas dominated by non-sprouting shrubs (*Arctostaphylos viscida*, *Ceanothus integerrimus, Ceanothus cuneatu*s, and in conifer forests, *C. velutinus* and *C. prostratus*), may have poor regeneration of shrubs and other fire-recruiting speices. Populations of species with fire-dependent recruitment (in the absence of soil disturbance) will be reduced as a result, and seed banks will be depleted. Thus, out of season burning can also reduce fire annuals and short-lived fire followers because their seed may not be present to germinate following the next fire at the site, and it does not disperse in from surrounding areas. These species are not likely to be resilient to these effects. Another factor that can contribute to reduced post-burn shrub recruitment is spring burning followed by rainfall sufficient to induce germination of surviving seeds. Seedlings that establish from such late germination have been found to have greater mortality during their initial summer (Moreno and Oechel 1993).

Burned areas of poor shrub regeneration will be more prone to invasion by yellow star thistle, cheatgrass and other annual grasses. The fine fuel of these annual grasses can carry fire and allow for a reburn before shrubs have begun to produce seeds. Also, mortality of young resprouts can occur, and shrubs are often too depleted to resprout again. Evidence suggests that successive, short rotation (< 5 years apart) fires can largely eliminate chaparral (Zedler et al. 1983). The shallow-rooted and quickly curing grass and weed vegetation that replaces chaparral under such type conversion will ignite more easily over a longer portion of the year, spread fire more rapidly, make slopes vulnerable to a future regime of more frequent fire and disturbances related to reduced slope stability in the absence of deep rooted shrubs.

III. Management Recommendations

While the draft management plan preferred alternative proposes burning chaparral, in part to improve winter deer forage, no information is provided demonstrating that forage is decreasing. A more prudent approach is to maintain existing stands rather than risk losing them entirely. Any burning that does occur, intentional or not, should be during the normal fire season and *must* be followed by exotic species control efforts such as spot spraying for yellow star thistle and other thistles using Transline. Control of annual grass invasion will be more difficult, but may be key to preventing a reburn and type conversion. Chaparral areas should not be included with grasslands targeted for frequent burning to help control non-native pest plants.

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Birds of the Cascade-Siskiyou National Monument

by Pepper W. Trail [1]

I. Overview of the Monument Avifauna

The Cascade-Siskiyou National Monument (CSNM) has a rich avifauna, reflecting its location at the crossroads between the Cascade, Great Basin, and Klamath-Siskiyou ecoregions. Field work over the past several years, combined with a review of records from Bureau of Land Management files and other unpublished sources, has produced a list of 202 bird species documented to occur within the CSNM presents this list, with data on species residency status, habitat preferences, and known localities of occurrence within the CSNM (Appendix I).

The Bureau of Land Management lists eighteen birds that are known or possible residents of the monument as "Special Status and Special Interest Species" (USDI BLM 2000, pp. 70-77). These are shown in Table 1, with a summary of their status and habitat requirements. This group of species is fairly varied, but a more complete list would be necessary to reflect adequately the diverse avian communities of the monument, including more species from oak woodlands (e.g. Acorn Woodpecker, Oak Titmouse), chaparral (e.g. California Towhee at lower elevations, Green-tailed Towhee at upper elevations), riparian woodlands (e.g. Willow Flycatcher, Yellow Warbler) and upper-elevation conifer forest (e.g. Gray Jay, Cassin's Finch).

Perhaps the most outstanding indication of the extraordinary avian diversity of the monument is the numerous bird species that reach regional range limits in the area. Figure 1 summarizes these bird distribution patterns for representative species (all maps from Csuti et al. 1998). Every possible pattern is seen, with the monument area representing the northern, southern, eastern, and western limits for different birds. This diversity of patterns emphasizes the critical role of the CSNM in providing biological connectivity between different bird communities of western North America.

The oak and chaparral habitats that occur at the Horseshoe Ranch, Agate Flat, and on south-facing slopes within the CSNM provide a home for a community of birds that reach a northern range limit in the monument area. Among the oak-associated species in this group are Acorn Woodpecker, Ash-throated Flycatcher, and Oak Titmouse. Among the chaparral-associated species are Blue-gray Gnatcatcher and California Towhee. In general, these species are found at low elevations, and the habitats they require are among the most threatened by residential and agricultural development on private lands.

Birds that reach a southern range limit in the monument area include Ruffed Grouse and Great Gray Owl. The Ruffed Grouse is found in mixed hardwood and conifers, usually associated with riparian areas with alders. The Great Gray Owl is found in conifer forests adjacent to open meadows, often at high elevations. Although this species extends locally into the Sierra Nevadas, the monument area represents the southwestern "corner" of its distribution.

Another group of species reaches a western range limit in the monument area. These include both birds characteristic of "eastside" ponderosa pine forests, such as the Williamson's Sapsucker and Pygmy Nuthatch, and birds characteristic of arid Great Basin habitats, such as Gray Flycatcher, Black-billed Magpie, and Canyon Wren. Important areas within the CSNM for these species include the drier forests at mid-elevations on the eastern side of the monument, and scattered sagebrush and rimrock areas along the upper south-facing slopes.

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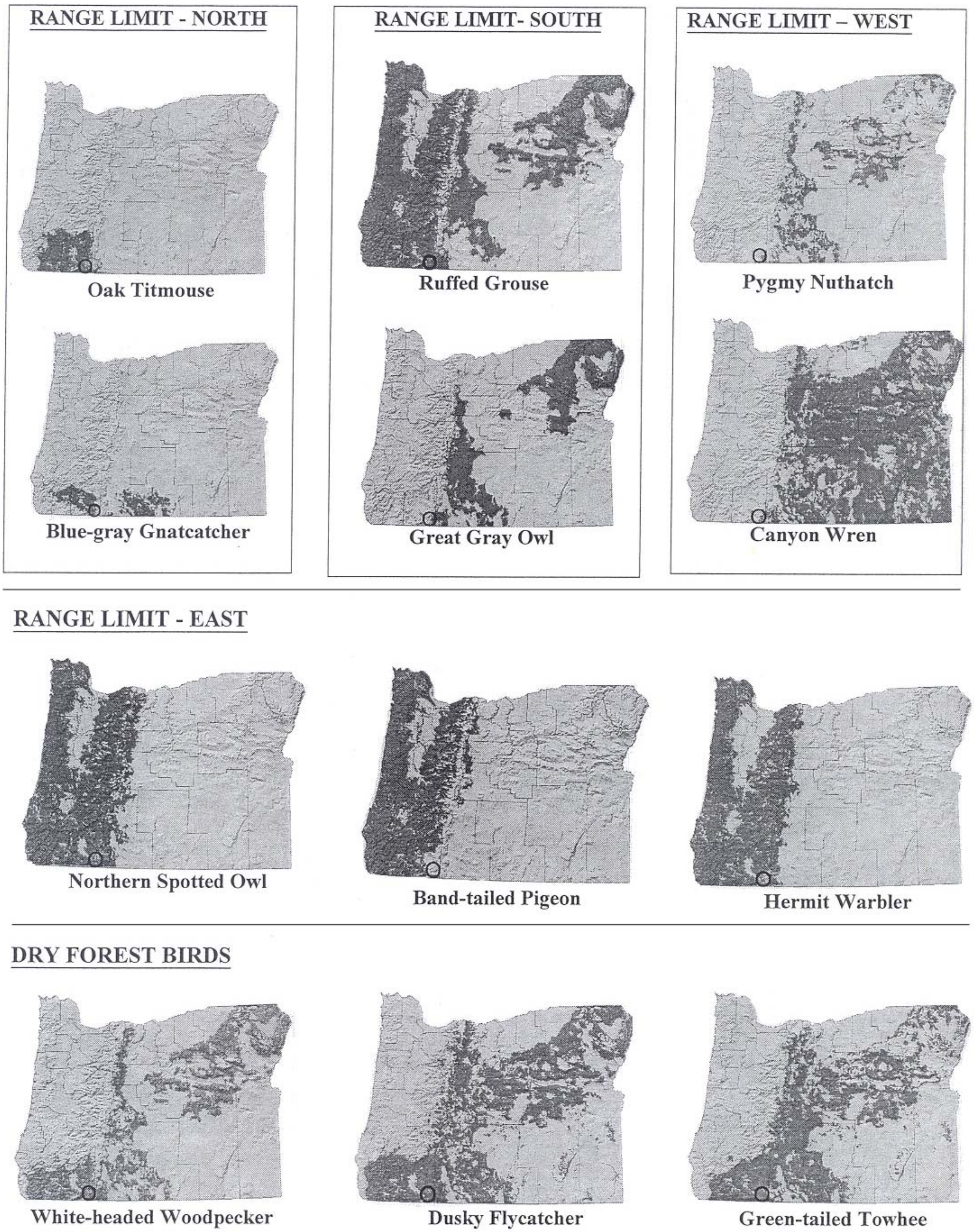
[1] Ornithologist, U.S. Fish & Wildlife Service, Ashland, OR

Figure 1. Bird distribution patterns in Oregon in relation to the Cascade-Siskiyou National Monument (CSNM). Species ranges are shown in dark shading; the location of the CSNM is shown by the circle. All maps from Csuti et al. 1998. Atlas of Oregon Wildlife, OSU Press.



A large number of species reach an eastern range limit in the monument area. These are principally species of relatively moist, well-developed conifer forests, such as those that were formerly widespread in the Coast Ranges and western Cascades. Examples include the Northern Spotted Owl, Band-tailed Pigeon, Chestnut-backed Chickadee, and Hermit Warbler. These species are widespread in suitable mid- to upper-elevation mixed conifer forests in the CSNM, particularly north of Highway 66.

Finally, there is an interesting group of bird species whose distribution stretches diagonally across Oregon. These birds occur from the Blue Mountains (faunistically part of the Northern Rockies) on the northeast to the Siskiyou Mountains on the southwest, and the CSNM lies squarely within this range. These species are generally adapted to relatively dry, open, fire-adapted forests and montane chaparral. Representative species include the Flammulated Owl, White-headed Woodpecker, Dusky Flycatcher, Mountain Chickadee, and Green-tailed Towhee.

In addition to these species that reach a range limit within the monument area, the CSNM is home to many birds that rely on specialized habitats that are increasingly scarce on both private lands and on public lands being managed for resource extraction. Examples include Northern Goshawk and Olive-sided Flycatcher (old-growth mixed conifers), Western Meadowlark (grasslands) and Willow Flycatcher (ungrazed riparian zones). The monument has the potential to act as a refuge for these species, which can then maintain “source” populations; that is, populations whose high reproductive success produces surplus individuals available for dispersal and the establishment of new breeding pairs.

II. Data Needs and Research Opportunities

The Cascade-Siskiyou National Monument provides numerous opportunities for important research in avian evolution, ecology, and conservation biology. The distribution and habitat preferences of birds within the monument are largely unknown, and numerous species remain to be definitively confirmed. Examples include Black-backed and Three-toed Woodpeckers, Black-chinned Hummingbird, and Brewer’s Sparrow. Many other species are known to occur in the monument, but breeding remains to be confirmed. Some of the species of greatest interest in this category are Prairie Falcon, Band-tailed Pigeon, Flammulated Owl, Williamson’s Sapsucker, Pygmy Nuthatch, Yellow-breasted Chat, and Vesper Sparrow.

The monument and its surrounding regions would also be an area of great interest for genetic analyses of population structure and gene flow. The opportunities can be illustrated with a quote from the most detailed phenotypic analysis ever done in the region, a study of the various forms of “Western Flycatcher” (*Empidonax difficilis*): “The results from Rogue River [National Forest] are surprising in that birds from this sample are perfectly typical of coastal *E.d. difficilis* in song while being intermediate between coastal and interior forms in size and color! … This population may be experiencing expanded variability because of the occasional input of interior birds into a population that is basically coastal… But the data for Siskiyou [County, California] are the most impressive of all. In terms of song syllables, one would judge Siskiyou [County] to be perfectly intermediate between coastal and interior samples. On the basis of size and color, however, both sexes illustrate enormously expanded variability, suggesting recombination and mating of diverse phenotypes. Either a hybrid swarm or a situation of secondary sympatry with limited hybridization seems likely. Certainly the interaction is not one of simple intergradation with intermediacy of size and color characters in the Siskiyou region; instead we are dealing with the most complex pattern of character change in the entire superspecies” (Johnson 1980, p. 92).

Such genetic variability is not merely of academic interest, of course. In the face of increased habitat fragmentation, populations of many bird species are becoming more isolated, and may ultimately lose the genetic heterogeneity necessary to adapt to changing conditions (see connectivity section). Even more than a treasure-trove of species, the monument and its surrounding region may represent a treasure-trove of genetic variation that will prove crucial in the response of species to global warming and other long-term environmental change.

Finally, the mosaic of monument habitats, and the management program to be carried out in coming years, provide tremendous opportunities for studying the effect of various activities on bird populations. Examples of these activities include grazing cessation, prescribed burning, riparian area recovery, alien plant control, and impacts of recreational activities. The proximity of the monument to Southern Oregon University makes it an ideal study site for undergraduate and master's-level projects, as well as faculty research. This is a connection that the BLM should actively foster as it develops management and monitoring plans.

III. Threats and Management Recommendations

No other part of Oregon exhibits such a diversity of bird distribution patterns within such a small area as does the Cascade-Siskiyou National Monument. The preservation of this remarkable diversity is dependent on the continued existence of the rich mosaic of habitats that occur within the CSNM. This mosaic may be enhanced, or it could be threatened, by monument management decisions. An extensive review of potential management impacts is beyond the scope of this document, but brief mention can be made of critical issues.

Grazing. Grazing has a great variety of negative effects on bird species (see review in Saab et al. 1995). Ground-nesting species such as California Quail, Killdeer, and Western Meadowlarks may be directly affected by trampling. Riparian species such as Willow Flycatchers, Yellow-breasted Chats, and Yellow Warblers may be eliminated by heavy grazing that removes streamside vegetation. Grazing is also a primary agent for the spread of alien grasses and weeds, degrading native grassland and oak-grassland habitats for birds. Grazing in forests and wet meadow habitats may promote the invasion of annual grasses and dense stands of white fir and Douglas-fir. This directly alters habitat suitability for many species, and has indirect negative effects on many others. For example, these habitat changes may reduce the prey base for raptors, and increase the likelihood of stand-replacing wildfires. Strict control or elimination of cattle grazing would enhance the bird habitats of the monument.

Roads. The role of roads in creating habitat fragmentation and environmental degradation has been exhaustively documented (see, for example, papers in *Conservation Biology* Vol. 14, No. 1, 2000). The impacts on bird species include: fragmentation of blocks of habitat required by forest-interior species; increased mortality and decreased breeding success due to the spread of edge-adapted predators and nest parasites; plant community alteration through the spread of alien plants; and increased incidence of wildfire ignitions. Closure and removal of roads wherever possible would increase habitat quality for birds as well as for many other species.

Fire Suppression. Fire suppression within the CSNM has produced unhealthy densities of small trees in some areas, particularly in previously logged areas. Many of these trees are fire-intolerant white firs that are able to out-compete pines in the absence of fire, markedly changing bird habitats. The numerous pine-adapted bird species form one of the most distinctive bird communities in the CSNM, and preservation of this community may require the careful reintroduction of prescribed fire into the monument and judicious management of wildfires to increase the amount of fire occurring in the monument.

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Table 1. "Special Status" bird species listed by the Bureau of Land Management for the Cascade-Siskiyou National Monument.

Common Name	Scientific Name	Breeding ?	Habitat Requirements
White Pelican	*Pelecanus erythrorhynchus*	No	Lakes; non-breeders occur annually on Hyatt Lake
Sandhill Crane	*Grus canadensis*	Possible	Wet meadows and "prairies"; known to breed just north of CSNM
Golden Eagle	*Aquila chrysaetos*	Probable	Old-growth forest with rocky or brushy openings. Regularly seen in CSNM, but no nest sites known.
Bald Eagle	*Haliaeetus leucocephalus*	Possible	Lakes and large streams. Known to breed just outside CSNM.
Northern Goshawk	*Accipiter gentilis*	Confirmed	Old-growth conifer forest.
Peregrine Falcon	*Falco peregrinus*	Confirmed	Cliffs for nesting.
Northern Spotted Owl	*Strix occidentalis*	Confirmed	Old-growth conifer forest; approximately 20 pairs are known within CSNM.
Great Gray Owl	*Strix nebulosa*	Confirmed	Old-growth conifers with meadows.
Flammulated Owl	*Otus flammeolus*	Probable	Mixed conifer and hardwood forest; little data in CSNM.
No. Saw-whet Owl	*Aegolius acadicus*	Possible	Dense conifer forest with meadows; little data in CSNM.
Lewis' Woodpecker	*Melanerpes lewis*	Possible	Oak savannahs and well-developed riparian woodlands with cottonwoods. Common in winter; breeding possible.
White-headed Woodpecker	*Picoides albolarvatus*	Possible	True fir and pine forest; little data from CSNM
Black-backed Woodpecker	*Picoides arcticus*	Possible	True fir forests and recent burns; confirmation within CSNM needed.
Three-toed Woodpecker	*Picoides tridactylus*	Possible	True fir forests and recent burns; confirmation within CSNM needed.
Pileated Woodpecker	*Dryocopos pileatus*	Probable	Old-growth conifer forest.
Pygmy Nuthatch	*Sitta pygmaea*	Possible	Open pine forest; little data in CSNM.
Western Bluebird	*Sialia mexicana*	Confirmed	Oak woodlands; suffers from competition with starlings.
Western Meadowlark	*Sturnella neglecta*	Probable	Grasslands; regular resident and probable breeder at Box O Ranch.

Appendix 1. **BIRDS OF THE CASCADE-SISKIYOU NATIONAL MONUMENT.**
This list includes 202 species that have been confirmed or are likely to occur within the CSNM. Species known to breed within the monument are marked with an asterisk. If no localities are noted, the species is either widespread or unpredictable in occurrence (e.g. many migrants), or is poorly known.

Status codes are as follows: R = year-round resident; M = spring and fall migrant; S = summer resident; W = winter resident; Br = confirmed to breed in CSNM; (Br) = may breed in CSNM, but confirmation needed.

Species	Status	Habitat Types	Localities	Notes
Loons & Grebes				
Common Loon	M	Lakes	Hyatt Lake	
Pacific Loon	M	Lakes	Hyatt Lake	Confirmation needed
Pied-billed Grebe	M,S, (Br)	Lakes	Hyatt; Parsnip Lakes?	
Eared Grebe	M	Lakes	Hyatt Lake	
Western Grebe	M	Lakes	Hyatt Lake	
Clark's Grebe	M	Lakes	Hyatt Lake	
Pelicans & Allies				
White Pelican	M,S	Lakes	Hyatt Lake	Wanders from Klamath Basin
Double-cr. Cormorant	M,S	Lakes	Hyatt Lake	Summer resident but non-breeder
Herons				
Great Blue Heron	M,S	Lakes & wetlands	Hyatt Lake, Jenny Creek	
Great Egret	M	Lakes & wetlands	Hyatt Lake	
Green Heron	M,S, (Br)	Lakes & creeks	Hyatt Lake, Jenny Creek ?	Confirmation needed
Waterfowl				
Tundra Swan	M	Lakes	Hyatt Lake	
Gr. White-fronted Goose	M	Lakes	Hyatt Lake	Records needed
Snow Goose	M	Lakes	Hyatt Lake	Records needed
Ross's Goose	M	Lakes	Hyatt Lake	Confirmation needed
Canada Goose*	M,S, Br	Lakes & wetlands	Hyatt Lake	
Wood Duck*	M,S, Br	Lakes & creeks	Hyatt Lake, Parsnip Lakes	
Mallard*	M,S, Br	Lakes & creeks	Hyatt Lake, Jenny Creek	
Gadwall	M	Lakes	Hyatt Lake	
American Wigeon	M	Lakes	Hyatt Lake	
Blue-winged Teal	M	Lakes	Hyatt Lake	
Cinnamon Teal	M	Lakes	Hyatt Lake	
Northern Shoveler	M	Lakes	Hyatt Lake	
Northern Pintail	M	Lakes	Hyatt Lake	
Green-winged Teal	M	Lakes	Hyatt Lake	
Canvasback	M	Lakes	Hyatt Lake	
Redhead	M	Lakes	Hyatt Lake	
Ring-necked Duck	M	Lakes	Hyatt Lake	
Greater Scaup	M	Lakes	Hyatt Lake	Records needed (vs. Lesser Scaup)
Lesser Scaup	M	Lakes	Hyatt Lake	
Barrow's Goldeneye	M	Lakes	Hyatt Lake	Records needed (vs. Com. Goldneye)
Common Goldeneye	M	Lakes	Hyatt Lake	
Bufflehead	M	Lakes	Hyatt Lake	
Ruddy Duck	M	Lakes	Hyatt Lake	
Common Merganser*	M, S, Br	Lakes & creeks	Hyatt Lake; Jenny Creek	
Hooded Merganser	M, S?	Lakes & creeks	Hyatt; Parsnip Lakes?	Summer records?
Birds of Prey				
Turkey Vulture	M,S, (Br)	Widespread		
Osprey*	M,S, Br	Lakes & creeks	Hyatt Lake	

Species	Status	Habitat Types	Localities	Notes
Bald Eagle*	M,S, Br	Lakes & creeks	Hyatt Lake	
Northern Harrier	M	Wet meadows, marshes		Migrant only?; summer records?
Sharp-shinned Hawk	R, (Br)	Conifers for nesting		
Cooper's Hawk	R, (Br)	Conifers for nesting		
Northern Goshawk	R, (Br)	Favors old-growth conifers		Records needed
Red-tailed Hawk*	M,S, Br	Widespread		
Red-shouldered Hawk	M	Favors riparian forests		One late-August record, Hyatt Lake
Rough-legged Hawk	M	Grasslands, open woodlands		Migrant only; confirmation needed
Golden Eagle	R, (Br)	Favors open country for hunting		
American Kestrel*	R, Br	Especially oak woodlands		
Merlin	M	Any forest type as a migrant		Migrant only
Peregrine Falcon*	M,S, Br	Cliffs for nesting		
Prairie Falcon	M, S?	Cliffs for nesting		Migrant only?; records needed
Gamebirds				
Ruffed Grouse	R, (Br)	Mixed hardwoods & conifers		
Blue Grouse	R, (Br)	Conifers		
Wild Turkey	R, (Br)	Oaks	Agate Flat, Box O	Introduced
California Quail	R, (Br)	Oak & chaparral		
Mountain Quail	R, (Br)	Montane chaparral		
Cranes & Allies				
Sandhill Crane	M, S?	Wet meadows, lake margins		Migrant only?; records needed
American Coot	M, S?	Lakes	Hyatt Lake	Migrant only?;summer records needed
Shorebirds				
Killdeer	M,S, (Br)	Lakeshores, creeks, rocky flats	Hyatt Lake	
Greater Yellowlegs	M	Lakeshores, creeks	Hyatt Lake	
Lesser Yellowlegs	M	Lakeshores, creeks	Hyatt Lake	
Spotted Sandpiper*	M,S, Br	Lakeshores, creeks	Hyatt Lake, Jenny Creek	
Sanderling	M	Lakeshores, esp. mudflats	Hyatt Lake	Probably rare transient
Dunlin	M	Lakeshores, esp. mudflats	Hyatt Lake	
Pectoral Sandpiper	M	Lakeshores, esp. mudflats	Hyatt Lake	
Western Sandpiper	M	Lakeshores, esp. Mudflats	Hyatt Lake	
Least Sandpiper	M	Lakeshores, esp. Mudflats	Hyatt Lake	
Long-billed Dowitcher	M	Lakeshores, esp. Mudflats	Hyatt Lake	
Common Snipe	M, S?	Wet meadows, grassy riparian	Hyatt Lake	Summer records needed
Wilson's Phalarope	M	Lakes and shores	Hyatt Lake	
Gulls & Terns				
Ring-billed Gull	M,S	Lakes	Hyatt Lake	Non-breeders summer at Hyatt
California Gull	M,S	Lakes	Hyatt Lake	Non-breeders summer at Hyatt
Caspian Tern	M	Lakes	Hyatt Lake	
Forster's Tern	M	Lakes	Hyatt Lake	
Common Tern	M	Lakes	Hyatt Lake	
Pigeons & Doves				
Rock Dove*	R, Br	Nests in human structures		
Band-tailed Pigeon	M,S?	Mixed conifer & hardwoods	Ridgetop elderberries in fall	Summer records needed
Mourning Dove	R, (Br)	Short grass, rocky flats, ranches		
Owls				
Barn Owl*	R, Br	Nests in human structures	Box O	
Flammulated Owl	M, S?	Favors pines		Confirmation needed
Western Screech Owl*	R, Br	Oaks, riparian, and mixed forest		
Great Horned Owl*	R, Br	Widespread		
No. Pygmy-Owl	R, (Br)	Favors oaks, but conifers also		
No. Spotted Owl*	R, Br	Old-growth conifers		
Barred Owl	R, (Br)	Conifers		Expanding range; records needed

Species	Status	Habitat Types	Localities	Notes
Great Gray Owl*	R, Br	Conifers near mountain meadows	Meadows near Hyatt Lake	
No. Saw-whet Owl	R?, (Br)	Thick forest, both mixed & conifer		Confirmation needed
Goatsuckers				
Common Nighthawk	S, (Br)	Rocky flats, dry forest clearings	Agate Flat, Box O	
Common Poorwill	S, (Br)	Rocky flats, hillsides		Confirmation needed
Swift & Hummingbirds				
Vaux's Swift	M,S, (Br)	Needs old growth for nesting		Nest records needed
Anna's Hummingbird	R, (Br)	Lower-elevation chaparral	Buckhorn Springs, Agate Fl	Resident at nectar feeders
Calliope Hummingbird	M,S, (Br)	High-elevation conifers, meadows		Records needed
Black-chinned Hummer	S?	Riparian in drier "eastside" sites	Agate Flat, lower Scotch?	Confirmation needed
Rufous Hummingbird	M,S, (Br)	Widespread		
Kingfisher				
Belted Kingfisher	R, (Br)	Creeks & rivers	Hyatt Lake, Jenny Creek	
Woodpeckers				
Lewis' Woodpecker	M,W	Oaks; non-breeder only?	Agate Flat, Box O	Summer records?
Acorn Woodpecker*	R, Br	Oaks	Tyler Creek, Agate Flat	
Williamson's Sapsucker	M,W	High-elevation conifers		Post-breed only? Confirmation needed
Red-breasted Sapsuckr*	R, Br	Widespread; conifers for breeding		
Red-naped Sapsucker	M,W?	Like Red-breasted Sapsucker		Confirmation needed; vagrant only?
Downy Woodpecker	R, (Br)	Primarily riparian hardwoods		
Hairy Woodpecker*	R, Br	Widespread		
White-head Woodpecker	R?	Favors open pine or fir forests	Upper Emigrant Creek?	Records needed
Northern Flicker*	R, Br	Widespread		
Pileated Woodpecker	R, (Br)	Old-growth conifers	PCT near Pilot Rock	
Flycatchers				
Olive-sided Flycatcher	M,S, (Br)	Favors old-growth conifers		
Western Wood-Pewee*	S, Br	Widespread		
Willow Flycatcher*	S, Br	Riparian	Buckhorn Springs, Box O	Records needed
Hammond's Flycatcher	S, (Br)	Primarily conifers		Usually in forest canopy
Dusky Flycatcher	S, (Br)	Drier, brushier forests than above		Tends to forage lower than Hammonds
Gray Flycatcher	S?	Primarily sagebrush		Confirmation needed
Pacific-slope Flycatcher	S, (Br)	Mixed forest, esp near water		
Say's Phoebe	M,W	Grassland, sagebrush		Summer records?
Ash-throated Flycatcher	S, (Br)	Oaks		Confirmation needed
Western Kingbird	S, (Br)	Oak woodland and grassland		
Vireos				
Cassin's Vireo	S, (Br)	Mixed forest and conifers		
Warbling Vireo	S, (Br)	Riparian	Buckhorn Spr, Parsnip Lks	
Hutton's Vireo	S, (Br)	Oaks		Records needed
Jays & Allies				
Gray Jay	R, (Br)	High-elevation conifers		
Steller's Jay*	R, Br	Conifers		
Western Scrub-Jay*	R, Br	Oaks		
Clark's Nutcracker	M	High-Elevation		Prob. Migrant only; summer records?
Black-billed Magpie	R?	Juniper, pine, or oak woodland	Agate Flat? Lower Scotch?	Records needed, esp in summer
American Crow	R?, (Br)	Prefers lower elevations, farms	Tyler Creek?	Confirmation needed
Common Raven	R, (Br)	Widespread		
Swallows				
Tree Swallow*	M,S, Br	Breeds near lakes and creeks	Box O	
Violet-green Swallow	M,S, (Br)	Breeds on cliffs		
Rough-winged Swallow	M,S?, (Br)	Breeds in banks		Confirmation needed

Species	Status	Habitat Types	Localities	Notes
Cliff Swallow*	M,S, Br	Nests on human structures	Hyatt Lake	
Barn Swallow*	M,S, Br	Nests on human structures	Hyatt Lake	
Chickadees & Allies				
Black-capped Chickadee	R, (Br)	Primarily riparian hardwoods	Buckhorn Springs	
Chstnut-backd Chickdee	R, (Br)	Mid-elevation Douglas-firs		
Mountain Chickadee	R, (Br)	High elevation, esp. true firs		
Oak Titmouse	R, (Br)	Oaks	Agate Flat, lower Scotch	
Bushtit	R, (Br)	Chaparral, oaks, riparian		
Nuthatches				
Red-breasted Nuthatch	R, (Br)	Conifers		
White-breasted Nuthatch	R, (Br)	Oaks and riparian hardwoods		
Pygmy Nuthatch	R?	Ponderosa pine	Oregon Gulch?	Records needed
Brown Creeper	R, (Br)	Conifers, favors old growth		
Wrens & Allies				
Rock Wren	R, (Br)	Cliffs and talus slopes	Boccard Point	
Canyon Wren	R? (Br)	Cliffs and canyons	Cathedral Cliffs?	Records needed
Bewick's Wren	R, (Br)	Oak and chaparral		
House Wren	M,S, (Br)	Favors buildings and clearcuts		
Winter Wren	R, (Br)	Old-growth, especially riparian		
American Dipper	R?, (Br)	Fast-flowing creeks		Records needed
Kinglets				
Golden-crowned Kinglet	R, (Br)	Conifers		
Ruby-crowned Kinglet	M,W	Widespread as migrant		Summer records needed
Thrushes & Allies				
Blue-gray Gnatcatcher	S, (Br)	Chaparral, oaks		Records needed
Western Bluebird*	R, Br	Oaks		
Mountain Bluebird*	R, Br	Mountain meadows	PCT near Soda Mt	Lower elevations in winter
Townsend's Solitaire	R, (Br)	Conifers, including junipers		
Swainson's Thrush	M, S?	Riparian or moist old growth		Confirmation needed
Hermit Thrush	R, (Br)	Conifers in breeding season		Most migrate south in winter
American Robin*	R, Br	Widespread		
Varied Thrush	M, S?	Moist conifer forest for nesting		Summer records needed
Wrentit	R, (Br)	Chaparral or riparian		
European Starling*	R, Br	Widespread, esp farms & houses		Introduced
American Pipit	M	Bare ground / alpine		Records needed
Horned Lark	M?	Bare ground / alpine		Confirmation needed
Cedar Waxwing	R, (Br)	Riparian and mixed forest		
Warblers & Tanager				
Orange-crownd Warbler	M,S, (Br)	Riparian, oaks, brushy forest		May occasionally overwinter
Nashville Warbler	M,S, (Br)	Chaparral, brushy forest		
Yellow Warbler*	M,S, Br	Riparian	Box O	
Yellow-rumped Warbler*	R, Br	Conifers		Breeds at hi elevation, winters at lower
Black-thrtd Gray Warbler	M,S, (Br)	Oaks, brushy forest		
Townsend's Warbler	M	Migrant only; conifers		
Hermit Warbler	M,S, (Br)	Conifers		
MacGillivray's Warbler	M,S, (Br)	Brushy wet meadows and riparian		
Common Yellowthroat	M,S, (Br)	Marsh/Wet Meadow		
Wilson's Warbler	M, S?	Riparian and brushy forest		Summer records?
Yellow-breasted Chat	M, S?	Riparian		Confirmation needed
Western Tanager	M,S, (Br)	Riparian and mixed forest		
Sparrows & Allies				
Green-tailed Towhee	M,S, (Br)	Montane chaparral	PCT near Soda Mt	
Spotted Towhee	R, (Br)	Brushy areas; widespread		
California Towhee	R, (Br)	Oak and chaparral	Buckhorn Sprgs,Agate Fl?	Records needed
Chipping Sparrow*	M, S, Br	Widespread		A few may overwinter
Vesper Sparrow	M,S, (Br)	Grassland; also junipers?		Records needed
Lark Sparrow	M,S, (Br)	Grassland and sagebrush		Records needed
Savannah Sparrow	R, (Br)	Grassland and wet meadows		Summer records?

Species	Status	Habitat Types	Localities	Notes
Fox Sparrow	M,W	Brushy areas		Summer records?
Song Sparrow	R, (Br)	Riparian, wet brushy areas		
Lincoln's Sparrow	M, W	Wet meadows and riparian		Summer records?
White-crowned Sparrow	M,W	Brushy areas		
Golden-crownd Sparrow	M,W	Brushy areas		higher elevation than White-crown
Dark-eyed Junco*	R, Br	Conifers and mixed forest for nest		Moves to lower elevation in winter
Black-headed Grosbeak*	M,S, (Br)	Riparian and mixed forest		
Lazuli Bunting*	M,S, Br	Brushy areas, oaks, chaparral		
Blackbirds				
Red-winged Blackbird*	R, Br	Wet meadows & marshy riparian	Box O	
Western Meadowlark	R, (Br)	Grasslands	Box O	
Brewer's Blackbird*	R, Br	Widespread; esp lakeshore,farms	Hyatt Lake	
Brown-headed Cowbird*	R,Br	Gathers around barns, corrals		Brood parasite
Bullock’s Oriole*	S, Br	Riparian	Box O	
Finches				
Gray-crwned Rosy Finch	W	Alpine; present only as vagrant		Records needed
Purple Finch	R, (Br)	Conifers and mixed woodland		
Cassin's Finch	R, (Br)	High-elevation conifers		
House Finch	R, (Br)	Nests on human structures		
Red Crossbill	R, (Br)	Conifers		Numbers fluctuate widely
Pine Siskin	R, (Br)	Conifers		
Lesser Goldfinch	R, (Br)	Riparian and oaks		
American Goldfinch	R, (Br)	Riparian and oaks		
Evening Grosbeak	R?	Conifers		Records needed: numbers fluctuate
House Sparrow*	R, Br	Human habitations and barns		

Peregrine Falcons

by Joel E. Pagel

I. Species Overview and Current Status

Peregrine falcons (*Falco peregrinus*) are among the world's most famous and impressive birds of prey. They are capable of diving at speeds approaching 200 miles per hour, and their mastery of the air is unsurpassed. Driven nearly to extinction by the widespread use of DDT, peregrines were among the first species listed under the Endangered Species Act. The return of peregrines across the continental United States was only accomplished through one of the most intensive recovery efforts ever attempted.

Banning of DDT in 1972 was the most important factor in the peregrine falcon's recent population increase. In addition, captive breeding and the controlled reintroduction of young birds to the wild ("hacking") was carried out in some portions of the country. These efforts, combined with rigorous monitoring and protection of nest sites, have increased the population of wild peregrines to the point that the species was removed from the endangered species list in 1999. This federal delisting decision was controversial, and the peregrine population in the Pacific Northwest continues to exhibit problems.

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Based on research on almost all peregrine falcon nest sites from northern California to the northern portion of Washington (except San Juan Islands), site protection is still necessary to protect peregrine falcons from disturbance during the nesting season (J. Pagel, unpublished data). Average eggshell thinning of peregrine falcons is approximately 24% thinner than historic levels; mean eggshell thinning in Oregon is approximately 17.9 % thin. Peregrine falcons are still breaking their eggs at a higher rate in southwest Oregon and northern California than in other locations in the Pacific Northwest. Based on these data and field observations, peregrines require continued monitoring, and in almost all instances nest site intervention to prevent anthropogenic disturbances which would adversely affect productivity.

In spring 2001, a pair of unbanded peregrine falcons reoccupied a historic nest site on Pilot Rock, within the newly-designated Cascade-Siskiyou National Monument. This location was last occupied by peregrine falcons in the late 1960's. The last time peregrine falcons nested on Pilot Rock (historically), a single chick was removed for falconry purposes (D. Fenske pers. com.).

Peregrine falcons are a Species of Special Concern for the BLM, and require continued protection, as well as protection from "take" under the Migratory Bird Treaty Act. To date, the BLM has not drafted or completed a management and/or monitoring plan for the nest site which would serve as interim guidance or direction for site protection, research, or baseline data collection, nor does the DEIS specify in detail what management practices will or will not be allowed within the immediate vicinity of the rock, as well as other practices which will be followed in adjacent habitat to prevent cumulative impacts to the peregrine falcon.

II. Threats

It is my professional opinion that peregrine falcons will not be sufficiently protected by any alternative that allows unregulated rock-climbing on Pilot Rock. Such activity is allowed under Alternatives A and D of the DEIS. Alternatives B and C both prohibit rock-climbing, but Alternative C would allow another activity known to disturb nesting peregrines, namely Hang Gliding/Para-Sailing. Climbing is not mutually exclusive with peregrines, but temporal and spatial restrictions are needed to eliminate the potential for take during the nesting season. The restriction period that I recommend is listed below. Given the history of use of Pilot Rock by rock-climbers, it seems unlikely that a complete ban on this activity will be a part of the final monument management plan, nor is it necessary if the biological needs of the peregrines during the courtship, nesting, and fledging periods within the below recommended restriction season are protected. Therefore, it is imperative that the final plan specify exactly what activities will allowed at what times of year, in order to avoid disturbance to this important nest site.

III. Management Recommendations

Below please find the basic Project Design Criteria that we have successfully used around most sites in the PNW.

1.) Restriction periods concurrent with site specific nesting chronology are imposed on known nest sites. These restrictions will generally adhere to the following guidelines based on elevation above sea level.

Low	1-2000 feet	1 Jan. - 1 July
Medium	2001 - 4000 feet	15 Jan. - 31 July
Upper	4001 feet +	1 Feb. - 15 Aug.

2.) Spatial boundaries (zones) around nest sites will be detailed on a site specific basis, but will generally follow these guidelines. All distances listed below are approximate ranges of concentric circles that are established using topographic boundaries, observed peregrine falcon behavior patterns, and other site-specific considerations. Site-specific distances WILL vary among nest sites. Management plans will delineate specific distances.

Primary: 0.25 to 0.75 mile "circle" around active nest cliff (average of 0.5 mile).
Secondary: 0.5 up to 2 air miles from active cliff.
Tertiary: 3 air miles from the active cliff.

These zones are imposed for disturbance and habitat management concerns.

3.) Spatial zones are to have the following restrictions.

<u>Primary</u>

1. Seasonal restrictions on human entry and activities are strictly followed.
2. Human activity (foot, vehicle, or aerial entry) within this zone is prohibited during the nesting season, except for peregrine falcon monitoring and related activities, law enforcement, or to preserve human life in emergencies.

3. No new human habitat alteration activity is planned within this zone (e.g. road or trail building, harvest, construction, recreation, ...).

Secondary

1. Seasonal restrictions are strictly followed.
2. New human activity (e.g. road construction, timber harvest, construction,...) is allowed outside of the nesting season, but is designed in such a manner as to benefit peregrine falcons and their prey.
3. Most recreation-related activities are permitted in this zone during the nesting season. Exceptions may include hang gliding, trail blasting, large group gatherings (e.g. Rainbow Family).
4. Harvest activity and habitat manipulation are to be designed to retain structure and function of the ecosystem in the immediate area of the nest cliff and surrounding habitat to augment production of prey for peregrine falcons. Silivicultural practices will use the best available information for protection and augmentation of avian prey populations, and will consider and create action alternatives which will benefit and support local biological diversity.

Tertiary

1. Seasonal restrictions for helicopter use and blasting are normally adhered to within this zone (exceptions noted in draft and final management plans). Small helicopters (e.g. Bell 205, 206, etc.) are normally permitted in this zone during the nesting season.
2. Proposed human-generated activities within this zone are scrutinized to determine potential affect to peregrine falcons.
3. Fire suppression activities within this zone will closely follow draft or final site specific management plans.
4. Aircraft (special use permit or Agency contracted/owned) are permitted outside of a 1500 ft AGL (above ground level) "bubble" around the nest site outside of the primary nest protection zone;however, aerial activities are restricted within the secondary boundary during the restriction period. Further, most aerial activity is permitted outside of the secondary management zone boundary during the restriction period.

The reasons for these restrictions at a nest site are based on nesting ecology of peregrine falcons that I have documented over the past 20 years. Courtship for peregrine falcons commences soon after winter solstice; photoperiodic changes affect male hormone levels. Peregrines lay 2-4 eggs in March-May, and commence incubation after the clutch is complete. Eggshell thinning induced by the metabolite of DDT, DDE, still affects populations in the Pacific Northwest and elsewhere, and residual levels of DDE continue to affect the reproductive success of peregrines. Reproductive failure at peregrine nests has been chronic in northern CA and OR due to eggshell thinning.

Eggs hatch after an incubation period of 31-33 days. Developing young are altricial and remain on the ledge while being fed and protected by both adults. Fledging occurs when the young are between 37 and 45 days of age. Juveniles continue to be fed and protected by the adults until they disperse, which can range from 3 weeks to 3 months. Peregrine falcons can be disturbed by human activity during the nesting season. Disturbance can cause nest sites and new territories to be abandoned; active nesting attempts to fail due to egg breakage; or can divert adult attention from opportunities to forage and feed young.

Based on site-specific observations collected in northern California, Oregon, and southern Washington since 1983, restriction periods for known peregrine falcon nest sites should be tailored to the specific nest, or if generalized, adapted to a range of elevations where the nest site is located [2]. While some variability in nesting restrictions exist due to known nesting chronology, peregrine falcon nest site chronologies have been established with enough rigor to show consistency. This has allowed us to prescribe reasonable restriction periods, with “extra” reasonable allowances for chronological “outliers.” For the peregrine falcons at Pilot Rock, I believe that a restriction period from 01 Feb. through 30 July would be necessary to protect the peregrine falcons. I also recommend that human access be allowed to the top of the rock, however all recreational rock climbing, hiking and other similar activities be restricted on the south, east and north side of the rock (roughly; more detailed information can be generated upon request) during the restriction period. Conversations with local climbers have indicated that such a seasonal ban would be acceptable.

It is my fervent opinion that the proposed alternatives within the DEIS have not been tailored to include peregrine falcons, and as they currently exist, may result in a “take” of the productivity of the Pilot Rock peregrine nest site, and further may cause the birds to disperse or otherwise vacate the territory. Cumulatively, there are numerous peregrine falcon nest sites throughout the Pacific Northwest that are being adversely affected; to date there is no monitoring program in place with sufficient rigor to document this affect to the species.

No alternatives within the DEIS specifically address temporal or spatial restrictions around this important peregrine nest site. The last known historical peregrine nest at this site failed when the single chick was removed for falconry purposes (D. Fenske pers. communication). It is extremely heartening that the nesting attempts in 2001 and 2002 were both successful, with two young fledging in each year; however this site probably could produce more young/year. It is unknown at this time if the productivity is related to eggshell thinning, ledge size, disturbance, or synergistic effects from these and other factors. Because this site is reproductively successful, it is important in the state. The nearest active peregrine nest is located approximately 15 miles away on the Rogue River National Forest.

To date, monitoring of the nesting ecology at the Pilot Rock nest site has not been rigorous. I laud the attempts by the biologists who have observed at the site to gain information on the nest site. However, it has appeared that peregrine monitoring is low priority and often does not get accomplished during the time periods when monitoring would be most efficacious. I believe that much information has been lost these first two years that would help discern the exact location of the nest site, territorial constraints for the adult peregrines, behavioral interactions with humans and other animals, and additional information on fledging behavior. Based on my discussions with local biologists and while this may sound critical, I do not believe that the biologists monitoring the site possess sufficient peregrine experience to discern subtle behaviors. Information gained from monitoring would augment extant data from other sites to better manage the Pilot Rock nest site to protect peregrines during the nesting season.

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[2] see Pagel, J. E. 1992. Monitoring protocol for peregrine falcons in the Pacific Northwest. Proceedings; symposium on peregrine falcons in the Pacific Northwest. US Forest Service, Medford, OR.

Butterflies and Moths

by Erik Runquist [1]

This document describes the current state-of-knowledge and overall status of, potential threats to, and management recommendations for, one of the most widely cited and species-rich Objects of Scientific Interest in the Cascade-Siskiyou National Monument: the butterflies and the lesser known moths that comprise the Lepidopteran fauna.

I. Overview of the Lepidopteran Fauna

The Cascade-Siskiyou National Monument (CSNM), with 112 known species, appears to hold the highest documented butterfly richness for an area of comparable size in all of Oregon and Washington (Runquist 1999, Runquist unpublished, other historic records). This total represents 92% of southwest Oregon's known butterfly species, two-thirds of the Oregon state total, and well over half of all species known from Oregon and Washington. Four species remain unconfirmed by the author since 1999, but four of these [2] are strays that are not permanent breeding residents within the CSNM. The current list of butterfly species known from prominent CSNM localities is included (Appendix I) and will serve to replace the list included as Appendix Q in the CSNM Draft Resource Management Plan/Environmental Impact Statement (USDI Bureau of Land Management 2002). Given additional work, the "final" CSNM butterfly total may reach or surpass a remarkable 115 species (but probably not the 120 species as suggested on page 62 of the Draft Management Plan).

Until the 1999 contracted surveys (Runquist 1999), there had been few formal butterfly studies of a defined region in southern Oregon. Tilden and Huntzinger (1977) surveyed and assembled historic records from Crater Lake National Park for butterflies from 1957-1962 but the Park has subsequently been poorly surveyed (if at all). Nice and VanBuskirk (1997) surveyed the Siskiyou Crest around Mount Ashland in 1996. Other areas in southwest Oregon like the Illinois River (Josephine County) are favorite sites for Lepidopterists, but specimens and records are scattered amongst dozens of these butterfly and moth enthusiasts. The known butterfly species lists for each of these areas are much shorter (around 80 species) than the CSNM's known list. Indeed, the length of Baldy Creek Road to Boccard Point single-handedly boasts a longer known species list (95 species) than any of these local sites and perhaps even all other comparable stretches of road in Oregon and Washington. Soda Mountain Road is a close second at 90 species. In contrast, the well-studied mountains of northern California (Shapiro 1986, 1991a, 1991b, 1997; Shapiro et. al 1981) possess species lists that are quite comparable to the CSNM. According to Jaccard's and Sorenson's similarity coefficients (quantitative comparisons of species assemblages), butterfly species richness and diversity in the CSNM appear to be more similar to these and other California sites than other nearby Oregon locales (Shapiro 1997, Runquist, unpublished).

While the number of butterfly species known from the CSNM is outstanding, the most interesting aspects are the assemblages of species with contrasting ranges that occur together here. For example, Sternitzky's Parnassian (*Parnassius smintheus sternitzkyi*) can be found on the same rabbitbrush flower as the Mormon Metalmark (*Apodemia mormo mormo*) at Boccard

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[1] Graduate student, Graduate Group in Ecology, University of California-Davis, Davis, CA.
[2] Becker's White (*Pontia beckerii*), Checkered White (*Pieris protodice*), Melissa Blue (*Lycaeides melissa*), Egleis Fritillary (*Speyeria egleis mattooni*).

Point in late summer. Sternitzky's is a post-glacial relict of the high rocky, cold temperate peaks of the Klamath-Siskiyou Mountains assemblage, while Mormon Metalmarks are a species of the arid and seasonally warm Great Basin. At the same site, Californian "endemics" like the Columbian Skipper (*Hesperia columbia*), Lindsey's Skipper (*H. lindseyi septentrionalis*), and the Gorgon Copper (*Lycaena gorgon dorothea*) reach or approach their northern range limits and fly with Cascadian species like the Great Arctic (*Oeneis nevadensis nevadensis*). There are few other places in the world that can claim these sympatries, and most of these sites can be seen from vistas in the CSNM. Butterflies certainly exemplify the "clash of ecoregions" that occurs in CSNM.

Significant areas of the CSNM nonetheless remain under-surveyed for butterflies. Areas that are especially lacking include the Agate Flats, the Soda Mountain Wilderness Study Area, the Jenny Creek area, and the Chinquapin and Little Chinquapin Mountains. Several rare or new CSNM species could be found in these areas including the Rural Skipper (*Ochlodes agricola*) and the Great Purple Hairstreak (*Atlides halesus estesi*).

In contrast to the CSNM's well-known butterfly diversity, moths remain essentially unsurveyed in the CSNM. Given its high butterfly and plant diversity, the CSNM moth potential is extremely high. A reasonable estimate of the CSNM moth total is probably around 2000 species. Approximately 1200 species of "macromoths" (wingspans generally greater than ½ inch, or 1.25 cm) are known from the Pacific Northwest and a similar number is expected in southwest Oregon and the CSNM (Miller and Hammond 2000, pers. comm.). Since February 2001, the author has casually collected over 250 species of moths on Neil Creek Road several miles west of the CSNM (with new species regularly being added), and efforts are currently underway to begin establishing at least a rudimentary CSNM moth list from a few select localities. With wingspans of often less than ½ inch, the truly unexplored areas of the Lepidoptera are the "micromoths." Thousands of micromoth species likely remain undescribed throughout North America and many species can only be identified by microscopic examination of their genitalia structures, wing venation, and other subtle characters by a handful of experts. Many new and significant regional moth records may be found in the CSNM. For example, a *Sericosema wilsonensis* (Family Geometridae) collected along the closed Schoheim Road (41-2E-10.1) near Salt Creek on June 29, 2001 is apparently only the second record for Oregon and the first from southern and western Oregon (P.C. Hammond pers. comm.).

II. Status and Threats to Lepidoptera in the CSNM

Many Lepidoptera have close and often specific associations with certain larval host plants. For instance, the presence of a Johnson's Hairstreak (*Callophyrs johnsoni*) indicates that western dwarf mistletoe (*Arceuthobium campylopodum*) is present high in a nearby conifer and the forest has significant old growth characteristics. Thus, Lepidopterans can be useful indicators of ecosystem health. Additionally, the Lepidoptera (and especially butterflies) have tremendous public appeal and are inspiration for advocates for conservation and the natural world. Indeed, the citation of butterflies in the Presidential Proclamation as a reason for establishing the CSNM (Proclamation 7318 of June 9, 2000) appears to be the first mention of Lepidoptera under the auspices of the Antiquities Act of 1906. The CSNM's butterfly diversity has been also cited in or been the focus of several television and newspaper reports including Cole (2000) and Kettler (2001).

Broadly speaking, butterfly and moth populations in the CSNM are healthy and regionally outstanding. However, certain species that exist in small or isolated colonies or are dependent on rare plants or sensitive habitats may be of concern for some management actions. Perhaps the most widely cited of these species is the Mardon Skipper (*Polites mardon klamathensis*, also locally referred to as the Klamath Mardon Skipper). However, the paucity of records for some butterflies from the CSNM (like the Bramble Green Hairstreak, *Callophyrs perplexa perplexa*, or Gold-hunter's Hairstreak, *Satyrium auretorum*) is not necessarily an indication of actual rarity or conservation concern. Timing, location, and a bit of luck are crucial to find additional populations of many species.

Habitat loss and alteration is the most pernicious threat to butterflies, and virtually every state or federally listed butterfly taxon owes its rarity to habitat loss and isolation. Complete anthropogenic habitat destruction is not a concern in the CSNM under the language of the Presidential Proclamation and the Draft Resource Management Plan, but the requisite habitats for certain patchily distributed species may become modified, fragmented, or degraded through the introduction and spread of invasive weeds, heavy cattle grazing, fire suppression (or unusually severe fires), soil erosion, altered hydrology, and some logging activities. Invasive weeds, fire suppression, and forest closure are discussed in detail below, as well as a detailed discussion of the Mardon Skipper.

<u>Invasive Weeds</u>

While CSNM designation affords the butterflies under its jurisdiction considerable protection and recognition, invasive weeds do not obey political boundaries. These alien weeds not only threaten native plant communities, but also can modify habitats and micro-communities to a degree that butterfly populations are extirpated or otherwise adversely impacted. Patchily distributed monophagous or oligiophagous (i.e. diets that are limited to one plant species or a handful of species) species can be potentially choked out by the unencumbered spread of invasive weeds. For example, alien shrubs like Scotch broom (*Cytisus scopularius*) are persistent problems for Mardon Skippers in Washington (Hays et. al. 2000) and the Fender's Blue (*Plebejus icarioides fenderi*) and the Oregon Silverspot (*Speyeria zerene hippolyta*) (Wilson et. al. 1997, McCorkle et. al. 1980) in Oregon.

In the CSNM, non-native annual and thatch-forming grasses like bulbous bluegrass (*Poa bulbosa*) and timothy (*Phleum pratense*) appear to be degrading the ideal Mardon Skipper bunchgrass habitat. The skippers tend to avoid patches of grasses (mostly alien annuals) taller than about one foot and concentrate their activity in low native California Oatgrass – Idaho Fescue dominated plant communities (Hays et. al. 2000, E. Runquist, personal observation). Efforts to control the spread of these and other alien grasses are of paramount management concern, and the plan outlined in the Preferred Alternative of the Draft Resource Management Plan may need to be enhanced (see section on key plant communities). In particular, there should be a strong management plan for controlling yellow star thistle invasion into monument grasslands.

<u>Fire and Forest Conditions</u>

The effects of prescribed fire or fire exclusion are not universal or equal across all butterfly species. In general, prescribed fire holds the potential for positive habitat modification by controlling invasive weeds, encouraging a diversity of herbaceous plants, and maintaining open forest conditions. Dark, closed-canopy forests are generally lower in butterfly species richness than in other patchy native habitats. This is, of course, not to say that darker late-seral forests are without Lepidopteran worth. For example, Johnson's Hairstreak (*Callophyrs* *johnsoni*) is one of Oregon's least encountered butterflies (Oregon Natural Heritage Program List 4, ONHP 2001) and is essentially an old growth obligate where its caterpillars feed on dwarf mistletoe (*Arceuthobium campylopodium*). Efforts to control dwarf mistletoe in the CSNM to reduce fire danger by removing mistletoe-colonized trees may harm local populations of Johnson's Hairstreak and the closely related dwarf mistletoe-associated Thicket Hairstreak (*Callophyrs spinetorum*). Only one individual has been recorded within the CSNM for both of these rare species, but this is not a good measure of the overall importance of the CSNM area as habitat for these species.

Dense vegetation can be a significant isolating problem for poor dispersing butterflies. This effect has been seen in on-going mark-recapture research in Colorado on the Dark Wood Nymph (*Cercyonis oetus*) (T.C. Emmel, pers. communication). Corridors between suitable, more open habitats can facilitate gene flow between butterfly populations (Ehrlich and Murphy 1987, Sutcliffe and Thomas 1996, Haddad 1999, Haddad and Baum 1999). Schultz (1998) however, contends that with the federally endangered Fender's Blue (*Plebejus icarioides fenderi*) of northwest Oregon, a series of "stepping stones" (not necessarily corridors) between existing habitat patches may be a more effective conservation and restoration tool. A similar situation may exist with the Mardon Skipper. Therefore, efforts to reduce the prevalence of young trees and shrubs should be beneficial as long as there are not detrimental effects to important host plants for butterflies and moths. Consultation with a Lepidopterist can help ensure that the latter is avoided.

Historically, fire has probably played a pivotal role in maintaining open forest conditions and facilitated inter-population gene flow for patchily distributed butterflies (Shuey 1997). However, the effects of even moderate and well-intentioned prescribed fires could be detrimental to species in which inter-patch movements appear to be limiting by naturally poor dispersal or limited by habitat fragmentation or isolation (Swengel 1994, Pickering 1997). For instance, historic populations of several skippers (including Mardon Skippers) appear to have been extirpated from one Washington locality due to several short-rotation prescribed fires (R.M. Pyle pers. communication).

It is difficult to provide a blanket recommendation for the "best" season for prescribed burns to have the lowest negative impacts on Lepidoptera populations. For numerous political and ecological reasons, summer burns (the most "natural" season) are not feasible. Spring and fall then are the only viable seasons. Unfortunately, spring and fall also correspond with the periods of growth and diapause for the immature stages of many Lepidopterans. It is in these largely immobile stages (egg, caterpillar, and pupae) that Lepidoptera are most vulnerable to the effects of fire and other disturbance agents. Of course, the life histories and flight periods of all butterfly and moth species are not the same, and thus the effects of fire in a particular season will not be equal. For instance, late spring and early summer burns could be less harmful to Mardon Skippers than fall burns by allowing some adults to fly away if necessary. A burn in the fall would likely kill a sizable portion of the population as they are in pupal diapause at ground level but may be healthier for their dependent bunchgrasses. A series of small fires rotated through subsets of a given habitat and conducted over multiple years may be vital to prevent the fire-induced extirpation of rare and local Lepidopterans. Large, vagile butterflies like the Western Sulfur (*Colias occidentalis chrysomelas*) with high colonization potential and large or poorly defined home ranges will likely not be impacted by all but the largest and most severe fires.

Nonetheless, local extirpation of some Lepidopterans is to be expected with prescribed burns and there are no easy answers for addressing this complication. If conducted carefully and habitats are restored though, the majority of extirpated populations can be quickly and healthily re-established via outside colonization. In general, it is recommended that a Lepidopterist with intimate knowledge of the Lepidofaunal composition and important larval hostplants of a targeted area should be consulted before the onset of a prescribed burn program.

The Mardon Skipper

The Mardon Skipper is a small, tawny orange skipper (Family Hesperiidae) that is classified as State Endangered in Washington (WAC 232-12-014) and is a Federal Candidate species for listing under the Endangered Species Act (USDI Fish and Wildlife Service 1999). Mardon Skippers were thought to be Washington State's only endemic butterfly until the 1979 discovery of an isolated population atop a serpentine ridge in northwestern Del Norte County, CA. Its presence in Oregon was confirmed in 1990 and 1991 in approximately seven disjunct meadow complexes along the crest of the Cascades in Jackson and Klamath Counties. An additional female may have been found in the Cascades of Siskiyou County, California east of Yreka in 1991. Virtually every known population in Oregon and California is near or dissected by roads, so the low number of known populations is probably misleading and many populations likely remain undiscovered in roadless or otherwise unexplored areas in southern Oregon and northern California.

The Mardon Skipper is at present only known from one complex of meadows in the CSNM. The Draft RMP/EIS (USDI Bureau of Land Management 2002) incorrectly implies that this population is in the vicinity of Soda Mountain at between 4500 and 4800 feet elevation. This description follows the inaccurate type locality information used in the original description of subspecies *P. mardon klamathensis* (Mattoon et. al. 1998). The actual location is on the western and southern slopes of Hobart Peak along and below Soda Mountain Road at between 5000 and 5300 feet.

The CSNM Draft Grazing Study (USDI Bureau of Land Management 2001) says that Mardon Skippers are "known to occur in only 3 meadows within the National Monument" (p. 30). In reality, these three meadows are merely larger openings within a complex of approximately 10 loosely connected forest clearings. Most of these openings are less than ½ acre in size. Mark-recapture data indicates that the Mardon Skipper population in each meadow is not distinct or segregated and functions as one interconnected population (Runquist unpublished). Some individuals have been recaptured within feet of where they were marked many days earlier while others have been found to move relatively large distances (even across the entire complex and back) within a few hours.

The boundaries of the Hobart Peak population have yet to be confidently defined, although the total area in which 90% of all individuals can be found during peak abundance may be as low as 50 acres (20.25 ha). Despite rather continuous meadows to the west and south of the population in a previously logged area, adults are rare there and never found in the same high concentrations that they are in the type locality "Mardon Meadows." This appears to be related to the dominance of non-native annual grasses and a general lack of the preferred native Oatgrass-Fescue association in these areas.

Mardon Skippers are also known from nearby meadow complexes along Little Hyatt Prairie Road and Road 39-3E-32 just west and north of Greensprings Summit and historically from Wildcat Glades along Road 39-3E-11 just north of the CSNM border near Hyatt Reservoir. Additional Mardon Skipper populations in the CSNM may be found in the vicinity of Chinquapin and Little Chinquapin Mountains.

Mattoon, Emmel, and Emmel (1998) designated the Hobart Peak Mardon Skipper population as the descriptive type locality of a new subspecies (*klamathensis)*. Thus, this population is of significant taxonomic importance and needs to be preserved for this reason alone. The Hobart Peak population is also the southern most known in Oregon.

The Draft RMP/EIS (USDI Bureau of Land Management 2002) states, "Although precise demographic information (size, survival) is unknown, the [Hobart Peak] population is thought to be small" (pg. 63). While it is true that scientifically rigorous censuses have not been fully completed for any Mardon Skipper population, the author initiated a mark-recapture study of the Hobart Peak Mardon Skipper population in June 2002. Results suggest that this population may be one of the largest known (Potter et. al. 1999, Runquist, unpublished) and the rough estimate of 200 individuals flying when the population was discovered on July 1, 1991 may be conservative. The stated concern about a "small" Hobart Peak population is thus only reflective of the relatively small acreage occupied by adult skippers. Where Mardon Skippers are found, they can be extremely abundant with high population densities. The average lifespan of individual adults is probably about two weeks with the entire population flying during a window of approximately four to five weeks. The average flight period is early June to early July with early and late records extending from mid-May to late-July in different years depending on the depth and duration of the winter snowpack.

The Mardon Skipper is an odd butterfly. Fescues are well established to be its wild larval hostplants across its range (Mattoon et. al. 1998, Hays et. al. 2000, Potter and Fleckenstein 2001, Runquist pers. observation). In the CSNM, it is Idaho fescue (*Festuca idahoensis*). However, as is typical of most grass-feeding skippers (subfamily Hesperiinae), Mardon Skipper caterpillars reared under laboratory conditions will eat and successfully complete metamorphosis on virtually any grass given to them, including aliens and grasses that do not grow their meadows (Newcomer 1966, Runquist pers. obs.). They do however appear to generally refuse pubescent California oatgrass (*Danthonia californica*) in captivity (Runquist pers. obs.). This refusal is significant because the short-statured oatgrass-fescue plant community is the favored habitat for adult skippers (Indeed, I look first for oatgrass and then the fescues around the margins when searching for Mardon Skipper populations). Oviposition has only been observed in bunches of fescues (Mattoon et. al. 1998, Potter et. al. 1999, Runquist pers. obs.), but it is possible that stray caterpillars may eat other nearby grass species. Further research on caterpillar behavior and host fidelity in the wild is needed.

Until 2002 the dispersal ability of individual Mardon Skippers had not been formally studied within any population. Although the resulting data have not been analyzed in depth, the mark-recapture study mentioned above has significantly improved our knowledge base and has confirmed frequent inter-meadow population movements. Males hover low to the ground (usually less than one foot) searching for females sitting in the grass. Females are quite sedentary and are most often seen when being courted by one or more males. The farthest any individual Mardon Skipper has been recorded away from the center of the Hobart Peak population were three "mudpuddling" males approximately ¾ mile (1.25 km) downslope on Baldy Creek Road (Runquist, pers. obs., June 8, 2001). Similarly, Mardon Skippers have never been recorded on the drier upper slopes of Hobart Peak despite an abundance of Idaho fescue.

III. Management Recommendations

The Cascade-Siskiyou National Monument is home to perhaps the most diverse and species rich butterfly assemblage in the Pacific Northwest. The populations of almost all species are healthy and of little management concern. The threats that are posed to some butterfly populations are not threats unique to those butterflies and can be addressed through careful management operations that serve to generally improve habitat quality, connectivity, and continuity. In general, management practices that serve to maintain, enhance, and restore native plant communities will also serve to protect and enhance the already healthy butterfly communities.

Habitat fragmentation and modification through the spread of invasive weeds, fire suppression, forest closure, and stand-replacing fire are the most significant issues and threats to the Lepidoptera in the CSNM. Displacement of native vegetation by non-native species, and damage to native vegetation by livestock are interrelated threats. It is unclear whether efforts proposed under the preferred alternative will be sufficient to stop, or even significantly slow the spread of non-native pest plants. As described in the section on key plant communities, yellow star thistle is the biggest threat in terms of habitat degradation and control and reduction of this species should be given top priority. The restriction of vehicles, well-funded eradication programs, and carefully conducted prescribed burns may facilitate reductions in the negative impacts of this and other weedy plants. A Lepidopterist with intimate knowledge of the Lepidofaunal composition and important larval host plants of a targeted area should be consulted before the onset of a prescribed burn program or any other vegetation management activities.

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Appendix I. Known butterfly fauna of the Cascade-Siskiyou National Monument and lists for surveyed areas. Compiled by Erik Runquist. Updated August 30, 2002.

Butterfly Species	Monument Locality									
	Baldy Cr. Rd. / Boccard Pt.	Soda Mtn. Rd.	Siskiyou Pass	Keene Creek	Scotch Creek	Chinquapin / Hyatt Res.	Pilot Rock	Porcupine Creek	Oregon Gulch	Agate Flat
SKIPPERS (HESPERIIDAE)										
Epargyreus clarus californicus	x	x		x	x	x		x		
Thorybes pylades indistinctus	x	x	x	x	x		x			
Erynnis icelus		x	x	x		x		x		
Erynnis propertius	x	x	x	x	x	x	x	x	x	
Erynnis pacuvius lilius	x	x								
Erynnis persius borealis	x	x	x	x	x	x		x		
Pyrgus ruralis ruralis	x	x	x	x		x		x		
Pyrgus communis	x	x	x	x	x	x				
Carterocephalus palaemon ssp.	x	x	x	x	x	x	x	x		
Hesperia juba	x	x	x	x		x	x	x	x	
Hesperia colorado oregonia/idaho	x	x	x	x		x	x		x	
Hesperia columbia	x	x	x			x	x			x
Hesperia lindseyi septentrionalis	x	x	x	x	x		x	x	x	x
Polites sabuleti aestivalis	x	x	x			x				
Polites mardon klamathensis	x	x								
Polites sonora sonora	x	x	x	x	x			x	x	
Atalopedes campestris campestris							x			
Ochlodes sylvanoides sylvanoides	x	x	x	x	x	x	x	x	x	x
Euphyes vestris vestris	x			x				x	x	
Amblyscirtes vialis	x	x		x	x			x	x	
SWALLOWTAILS (PAPILIONIDAE)										
Parnassius clodius claudianus	x	x		x	x	x				
Parnassius smintheus sternitzkyi	x	x	x		x		x			
Papilio zelicaon zelicaon	x	x	x	x	x	x	x		x	
Papilio indra shastensis	x		x							
Papilio rutulus rutulus	x	x	x	x	x	x	x	x	x	
Papilio multicaudatus pusillus	x	x	x	x	x	x	x	x		
Papilio eurymedon	x	x	x	x	x	x	x	x	x	
WHITES AND SULFURS (PIERIDAE)										
Neophasia menapia menapia	x	x		x	x	x	x	x	x	
Pontia beckerii	x		x				x			
Pontia sisymbrii sisymbrii	x	x	x			x	x	x		
Pontia protodice			x							
Pontia occidentalis occidentalis	x	x	x		x					
Pieris marginalis castoria	x	x	x	x	x	x	x	x		
Pieris rapae rapae	x	x	x		x	x	x	x		
Euchloe ausonides "ausonides"	x	x	x	x	x	x	x	x		
Anthocharis sara sara	x	x	x	x	x	x	x	x	x	
Anthocharis lanceolata lanceolata	x	x	x	x	x	x	x	x	x	
Colias philodice eriphyle		x	x	x	x		x			
Colias eurytheme	x	x	x	x	x	x	x	x	x	x
Colias occidentalis chrysomelas	x	x	x	x	x	x	x	x	x	

Butterfly Species	Monument Locality									
	Baldy Cr. Rd. / Boccard Pt.	Soda Mtn. Rd.	Siskiyou Pass	Keene Creek	Scotch Creek	Chinquapin / Hyatt Res.	Pilot Rock	Porcupine Creek	Oregon Gulch	Agate Flat
GOSSAMER-WINGS (LYCAENIDAE)										
Tharsalea arota virginiensis					x					
Lycaena xanthoides nigromaculata	x	x	x	x		x			x	
Lycaena gorgon dorothea	x		x		x		x	x	x	
Lycaena heteronea ssp.	x	x	x		x	x	x	x		
Lycaena helloides helloides	x	x	x	x		x				
Lycaena nivalis blend	x	x	x	x	x	x	x	x	x	
Habrodais grunus lorquini	x	x		x	x					
Satyrium fuliginosum ssp.	x		x	x						
Satyrium californica californica	x		x	x	x				x	
Satyrium sylvinum nootka		x	x	x	x				x	x
Satyrium auretorum auretorum	x									x
Satyrium tetra	x	x			x				x	
Satyrium saepium saepium	x	x	x	x	x		x		x	x
Callophyrs nelsoni	x	x	x	x	x	x	x	x	x	
Callophyrs johnsoni						x				
Callophyrs spinetorum spinetorum				x						
Callophyrs perplexa perplexa	x	x				x				
Callophrys sheridanii lemberti	x	x					x			
Callophyrs augustinus iroides	x	x	x		x		x			
Callophyrs mossii windi								x		
Callophyrs eryphon eryphon				x	x	x			x	
Strymon melinus atrofasciata	x	x			x	x	x	x		
Everes comyntas sissona	x	x				x		x		
Everes amyntula amyntula	x	x	x	x	x		x		x	
Celastrina echo	x	x	x	x	x		x	x	x	
Euphilotes intermedia intermedia	x	x	x	x	x	x	x	x	x	
Euphilotes enoptes "enoptes"		x	x		x		?		?	
Euphilotes "aridorum" complex*			x							
Glaucopsyche lygdamus columbia	x	x	x					x	?	
Lycaeides anna ricei	x	x	x	x	x	x	x	x	x	
Lycaeides melissa melissa			x							
Plebejus saepiolus rufescens	x	x	x	x	x	x	x	x	x	
Plebejus icarioides helios	x	x	x	x	x		x		x	
Plebejus acmon acmon	x	x	x	x	x	x	x	x	x	x
Plebejus lupini lupini	x	x	x		x	x	x	x	x	x
METALMARKS (RIODINIDAE)										
Apodemia mormo mormo	x	x	x		x					
BRUSHFOOTS (NYMPHALIDAE)										
Speyeria cybele pugetensis	x									
Speyeria coronis coronis/snyderi	x	x		x						
Speyeria zerene conchyliatus	x	x	x	x	x	x	x	x	x	x
Speyeria callippe elaine	x	x	x	x	x	x	x	x	x	x
Speyeria egleis mattooni		?	x	?						
Speyeria hesperis dodgei		x	x			x				
Speyeria hydaspe blend	x	x	x	x	x	x	x	x	x	
Boloria epithore chermocki	x	x	x	x	x	x	x	x	x	
Thessalia leanira oregonensis	x	x						x		

Butterfly Species	Monument Locality

	Baldy Cr. Rd. / Boccard Pt.	Soda Mtn. Rd.	Siskiyou Pass	Keene Creek	Scotch Creek	Chinquapin / Hyatt Res.	Pilot Rock	Porcupine Creek	Oregon Gulch	Agate Flat
Chlosyne palla palla	x	x	x	x	x		x	x	x	
Chlosyne hoffmanni segregata	x			x		x				
Phyciodes pulchella inornatus	x	x	x	x	x	x	x	x	x	
Phyciodes orseis orseis	x		x						x	
Phyciodes mylitta mylitta	x	x	x	x	x	x	x	x	x	x
Euphydryas chalcedona chalcedona	x	x	x	x	x	x	x	x	x	x
Euphydryas editha rubicunda	x	x	x				x	x		
Polygonia satyrus neomarsyas				x	x					
Polygonia faunus rusticus	x	x		x		x		x	x	
Polygonia gracilis zephyrus	x	x		x	x	x	x	x	x	
Polygonia oreas silenus				x	x					
Nymphalis californica	x	x	x	x	x	x	x	x	x	x
Nymphalis antiopa antiopa	x	x	x	x	x	x		x	x	
Nymphalis milberti subpallida	x	x	x				x			
Vanessa atalanta rubria	x	x							x	
Vanessa virginiensis	x	x					x			
Vanessa cardui	x	x	x			x	x			
Vanessa annabella	x	x	x							
Junonia coenia grisea	x	x	x			x			x	x
Limenitis lorquini lorquini	x	x	x	x	x	x	x	x	x	x
Adelpha bredowii californica	x	x	x	x	x	x	x	x	x	x
Coenonympha california eryngii	x	x	x	x	x	x	x	x	x	x
Cercyonis pegala ariane	x	x	x	x	x	x	x	x	x	x
Cercyonis sthenele silvestris	x	x		x	x				x	x
Cercyonis oetus oetus	x	x	x			x	x		x	
Oeneis nevadensis nevadensis	x	x	x	x	x	x	x	x		
Danaus plexippus plexippus	x	x	x	x		x	x		x	x
Number of Confirmed Species:	**95**	**90**	**81**	**69**	**68**	**63**	**62**	**57**	**55**	**21**

* May be conspecific with *Euphilotes enoptes*

Aquatic Environments and Associated Fauna

by Michael S. Parker [1]

I. Overview of Habitats and Organisms

Aquatic habitats, and the organisms inhabiting them, within the Cascade-Siskiyou National Monument (CSNM) are reflections of the diverse landforms, climatic conditions and vegetative communities in which they are embedded. The diversity of aquatic systems include both lentic and lotic habitats ranging from vernal pools associated with mound-and-swale topography to small, shallow lakes, and from a variety of seeps, springbrooks and small, intermittent and perennial streams to larger, fish-bearing streams.

Among streams draining the mountainous topography of the CSNM are tributaries to two major river systems, the Klamath to the south and Rogue to the northwest. A feature significant to the conservation and management of these aquatic resources is that watersheds, or significant portions of watersheds, of several tributaries are located entirely within the boundaries of the monument, allowing for conservation and management at appropriate scales (e.g. Doppelt et al. 1993).

Lentic Habitats

Little specific information, based on detailed research, is available for aquatic communities associated with many of the habitats within the monument. Preliminary surveys clearly show biological diversity to be high, and including a large number of rare and endemic species. For example, surveys of vernal pools southeast of Highway 66, near the town of Lincoln, have revealed a diverse invertebrate fauna, including most taxa common to this type of seasonal habitat (Helm and Fields, Oregon Natural Heritage Program 1998).

Vernal pools are a regionally significant habitat that harbors unique communities of plants and animals (Jain 1976). For example, vernal pools on the Agate Desert of southwest Oregon harbor a number of plant species not known to occur anywhere else in the world. Recent discovery of disjunct populations of the federally-listed vernal pool fairy shrimp (*Branchinecta lynchi*) in Agate Desert vernal pools further illustrates their value in supporting rare species. Most areas where these habitats were once abundant have been highly altered by agricultural and residential development, and vernal pools currently occupy small portions of their historic range. Although restricted to a small area of the monument, vernal pool habitats remain ecologically intact, and more detailed surveys will undoubtedly reveal a flora and fauna rich in species found nowhere else in the region.

Small, shallow lakes, such as Parsnip and Hobart Lakes, represent habitats relatively rare in the southern Cascades and Siskiyou Mountains. Naturally fishless, these are particularly important habitats for pond-breeding amphibians such as the Pacific chorus frog (*Pseudacris regilla*), western toad (*Bufo boreas*) and rough-skinned newt (*Taricha granulosa*), and may also be inhabited by rare species, such as the spotted frog (*Rana pretiosa*) whose populations are in decline throughout their range (Hayes 1994). The last known record of spotted frog in Jackson County was near Little Hyatt Lake approximately 4 km NE of the Parsnip Lakes.

Since most small lakes and ponds in the region have been stocked with non-native fish, the current and future value of habitats such as the Parsnip Lakes for conservation of native

[1] Associate Professor, Department of Biology, Southern Oregon University, Ashland, OR

aquatic communities is, and will remain, very significant. In addition to conservation of amphibian populations, these habitats also support diverse invertebrate assemblages. Perhaps the most visible illustration of this is the high diversity of dragonfly and damselfly species (order Odonata) inhabiting the Parsnip Lakes (M. S. Parker, personal observations), the adults of which can be seen in abundance throughout the northern monument and surrounding areas. Odonates are often top predators in fishless ponds and small lakes, and thus play important ecological roles within these systems.

Lotic Habitats

The most studied aquatic habitats within the monument are fish-bearing streams, in particular Jenny Creek and its tributaries. Although the fish fauna has relatively few species, there are interesting distributional patterns within and among drainages that illustrate how the juxtaposition of different ecoregions results in greater overall biodiversity within this relatively small area. For example, fish species within Jenny Creek and the other Klamath River tributaries have affinities to the Great Basin fish fauna (redband trout, speckled dace), while Emigrant Creek and its tributaries have species common to coastal, inland valley and Cascade mountain faunas (rainbow and coastal cutthroat trout and reticulate sculpin).

In addition to these distributional patterns of interest, there is considerable within-species diversity due to a high degree of isolation among populations, particularly within Klamath River tributaries. A series of ancient basalt flows in the lower reaches of Jenny, Camp, and Scotch Creeks create barriers to upstream fish migration that have effectively isolated upstream populations for several thousand years. For example, the so-called Jenny Creek sucker is a unique population of Klamath small-scale sucker (*Catostomus rimiculus*) with morphological (smaller size) and life history (early maturation and short life span) characteristics distinct from populations of this species inhabiting the Klamath and Rogue rivers (Hohler 1981, Rossa 1999). This population is currently identified as a 'Species of Concern' by the Oregon Department of Fish and Wildlife (ODFW) and the Bureau of Land Management (BLM).

In addition to *C. rimiculus*, Jenny Creek is inhabited by two other native fish species, inland rainbow, or redband, trout (*Oncorhynchus mykiss*) and speckled dace (*Rhinycthyes osculus*). An isolated redband trout population also occurs in the Camp/Dutch Oven Creek drainage, which may be one of very few remaining populations of this species in the Klamath watershed not negatively affected by introduced hatchery rainbow, or other non-native trout species. These isolated populations represent unique and regionally significant evolutionary lineages.

In addition to fish populations, larger streams, such as Jenny Creek and its tributaries, are inhabited by amphibian and reptile species whose populations are in decline elsewhere in the region. Among these, the western pond turtle (*Clemmys marmorata*) and foothills yellow-legged frog (*Rana boylii*) are noteworthy. Though little detailed information on their abundance and distribution is available, habitats within the CSNM likely provide refugia for these and other species, allowing them to maintain populations within the region.

Although the major focus of past studies has been on fish, and other vertebrate species, perhaps the greatest diversity in lotic habitats is to be found among the invertebrates. For example, Frest and Johannes (1999) surveyed springs and larger tributaries within the Jenny Creek drainage and found a very high diversity of snail species within the family Hydrobiidae (so-called pebble snails due to their small size), including at least seven species new to science. Recognized for their conservation value, due to localized distributions and high diversity, these species are included in the list of Survey and Manage species in the Northwest Forest Plan.

Isolated populations of hydrobiids have also been found in Dutch Oven and Scotch Creeks (Parker 1999) and are likely present in many springs and small streams throughout the monument. Periodic surveys of benthic invertebrates, conducted for the U. S. Forest Service and BLM by R. Wisseman and associates, have also shown high levels of diversity among the many streams within the monument. These stream communitites include a mixture of faunal elements associated with Great Basin, coastal, and cool, montane headwater drainages.

In addition to fish-bearing streams, seeps, springs, and intermittent streams are also important aquatic habitats that harbor unique and diverse communities of plants and animals. The hydrobiid snails described above are but one indicator of the value of these types of habitats. Isolated pools in intermittent streams, such as Oregon Gulch and Skookum Creek, provide valuable amphibian breeding habitats (Parker 1999), and lower reaches of these streams may be important spawning sites, and provide refuge for juvenile fish, particularly during winter floods and periods of high spring runoff. Riparian vegetation associated with springs, and along channels of intermittent streams also provide habitat to a diversity of migratory and resident songbirds, small mammals, reptiles, and terrestrial invertebrates.

II. Threats to Aquatic Biodiversity

The list of threats to aquatic habitats within the CSNM include impacts of human activities common to aquatic environments throughout the western U.S. Among these are (1) stream channelization, impoundment, and redistribution of water for irrigation and livestock watering, with resulting changes in sediment supply and distribution, (2) negative effects of domestic livestock on riparian vegetation, bank stability, nutrient loading and erosion, (3) invasion by non-native species, (4) effects of roads and road crossings on sediment delivery and stream channel morphology, and (5) potential negative effects of catastrophic wild fire in watersheds affected by decades of fire suppression and build up of fuels.

Many of these above-mentioned activities occurring outside the monument boundaries, or on private lands embedded within the monument, can have negative impacts on the monument's aquatic systems. For example, current timber harvesting and associated road building and maintenance activities on private timberlands within the Johnson Creek drainage (a major tributary of Jenny Creek) could be having negative impacts on temperature and fine sediment delivery within lower Jenny Creek. Similar effects of past logging activities on private land within the East Fork Camp Creek drainage have resulted in higher stream temperatures and large amounts of fine sediment delivered to the channel (particularly from erosion of unmaintained roads). Together, these effects have resulted in diminished stream habitat for the resident redband trout population.

Sedell (2001) compared stream habitats and fish populations between the East Fork of Camp and Dutch Oven Creeks and found that pool density, maximum pool depth, and pool volume was much higher in Dutch Oven Creek. He also found that fish densities were much higher, and consisted of a wider ranges of age and size classes in Dutch Oven Creek than the East Fork of Camp Creek. Dutch Oven Creek is one of three main forks of the Camp Creek drainage which has experienced much less impact due to logging within its watershed. Restoration of these watersheds should begin with repair or removal of abandoned roads, which are the primary sources of fine sediments to their channels.

Large and small impoundments on mainstem and tributary streams outside the monument, such as Howard Prairie Reservoir on upper Jenny Creek and Little Hyatt and Keene Creek reservoirs on Keene Creek, have large effects on the hydrologic regime and sediment delivery to downstream reaches of these streams within the monument. These effects often translate into alterations in the natural disturbance regime resulting in altered food web structure and reduced and energy flow to fish (Parker 2000, Parker et al. 2002). These impoundments are also sources of non-native species of fish, amphibians, and aquatic plants that enter, and in some cases proliferate, within monument streams.

Past stocking of hatchery-raised rainbow trout by ODFW into Jenny Creek, and continued stocking in upstream reservoirs, has resulted in the introduction of non-native strains of this species into the system, with potentially negative ecological and evolutionary consequences for resident redband trout. Other non-native fish and amphibian species that have been introduced via upstream and downstream impoundments include brown bullhead (*Amiurus nebulosus*), golden shiner (*Notemegonus chrysoleucus*), and bullfrog (*Rana catesbiana*). Invasive aquatic plant species include curly-leaf pond weed (*Potamogeton crispis*), Eurasian water millfoil (*Myriophylum spicatum*), and western and Brazilian elodea (*Elodea canadensis* and *Egeria densa* respectively).

The impact of these species on Jenny Creek and its tributaries has not been well documented, but where they have become abundant they may have large effects on the flow regime, temperature, sediment composition, and species composition of the invertebrate community. These effects would most likely be negative to native fishes and amphibians and support higher densities of non-native species (e.g., bullfrog and warm water fishes) within the drainages in which these plants become naturalized and abundant (e.g. Kupferberg 1996).

Although most streams within the monument are not affected by large, upstream impoundments, many have been affected, to varying degrees, by smaller, off-channel impoundments built primarily as stock ponds (often referred to as pump chances). These ponds are typically built near the headwaters of a small stream, adjacent to the stream channel, and receive water through a pipe placed in the stream to capture stream flow when discharge is high. Often small "push-up" dams are constructed to facilitate piping of stream water into the pond. In some cases, such as in upper Skookum and Scotch Creeks, small impoundments are built directly in the stream channel.

Although these ponds provide breeding habitat for certain amphibian species (Pacific chorus frog and rough-skinned newt) and may be used as watering and feeding sites for birds, bats and other small mammals, they may, in many cases exert strong negative impacts on stream habitat. For example, functioning as stock ponds these small impoundments often attract large numbers of livestock which then move into the nearby stream channel causing increased bank erosion, destruction of riparian vegetation and higher nutrient inputs. Although these activities take place in a relatively restricted area of the watershed, their impacts can extend for great distances downstream. The continued use of these ponds should be closely evaluated and discontinued if negative impacts persist.

In addition to localized effects in and around artificial ponds, the effects of domestic livestock are perhaps the most widespread and destructive impacts on aquatic habitats throughout the monument. Particularly hard hit are seeps and springs where cattle tend to congregate during dry, hot summer months. These systems are easily disrupted due to increased sedimentation and removal of vegetation. They are also often associated with headwaters of larger streams and so are sources of fine sediments and nutrients to stream channels. Because these habitats potentially harbor unique, perhaps endemic organisms (e.g. Frest and Johannes 1999), they should be protected from further damage by livestock trampling. The removal of livestock from portions of larger streams like Jenny Creek, and comparison of streams with low livestock activity, like Dutch Oven Creek, with streams experiencing relatively heavy livestock activity, like upper East Fork of Camp Creek, reveal that limiting livestock access results in reduced erosion and fine sediment inputs and improved riparian conditions. Likewise, spring sources from which livestock have been excluded have more diverse and denser riparian vegetation, better water quality, and support more diverse assemblages of aquatic organisms.

III. Management Recommendations

The overall goal for managing aquatic environments within the monument should be to recover and maintain the natural hydrologic processes that support native aquatic and associated riparian communities. Management should focus on (1) reducing or eliminating current impacts to watersheds within the monument, (2) restoring habitats damaged by past activities, and (3) preventing potential future impacts caused by activities within and adjacent to the monument. During the process of modifying habitat-disturbing practices and restoration, careful monitoring will be required to determine the outcomes of these activities on the structure and function of the systems being managed.

Inventories need to be conducted to fill important data gaps before an ecologically sound management plan addressing aquatic environments can be formulated. While there is considerable evidence indicating that livestock grazing, poorly constructed and maintained roads, and non-native species are specific threats to aquatic environments in the monument, there is little detailed information identifying the location and extent of these impacts. Information gaps relative to floral and faunal communities associated with the complete range of aquatic habitats, the condition of riparian vegetation, and conformance of watercourses to each of the 14 Oregon Department of Environmental Quality standards throughout the monument need to be filled by conducting field inventories at the appropriate scale. The results of these efforts are critical to the development of a management plan that comprehensively addresses the full range of degraded and intact areas.

Among current impacts to aquatic systems, livestock grazing within riparian areas is perhaps the most destructive and widespread and should be strictly curtailed or eliminated. At a minimum, livestock should be excluded from seeps and springs and areas surrounding seasonal wetlands and lakes. Stock ponds adjacent to springs and streams should be carefully evaluated to determine if they are having detrimental effects, direct or indirect, on natural flow regimes, sedimentation, and riparian vegetation. These sites should be evaluated to determine if they harbor, or influence the distribution of exotic species (e.g. bullfrogs, warm water fishes, and aquatic plants). Small impoundments within the active channels of intermittent or perennial streams should be removed. Removal of stock ponds will likely require active restoration of the pond site, including removing pipes, canals, and berms, filling depressions, and reestablishing native vegetation. If livestock grazing continues after the management plan for the monument is completed and implemented, then stock ponds should be located far from sensitive riparian areas.

Poorly constructed and maintained roads threaten some aquatic systems within the monument by altering runoff patterns, causing erosion, delivering fine sediments to stream channels and may act as barriers to upstream fish movement. A number of roads have been closed to limit motor vehicle traffic and others have been proposed for closure. Even roads that have been unused for several years can continue to erode and alter surface runoff. Therefore, it is not sufficient to simply close roads to vehicle traffic, and active restoration to reestablish natural hillslope contours and native vegetation will likely be required (e.g., Havlick 2002). It will be necessary to inventory existing and former roads within monument watersheds to identify sites where negative impacts are occurring or most likely to occur, and target these sites for restoration. Particular attention should be paid to roads that closely parallel stream channels, intercept lateral flow into the channel, and road crossings that contribute fine sediments or cause channel incision downstream of a culvert.

Non-native aquatic species are most abundant within the Jenny Creek drainage, with upstream reservoirs providing source populations. Habitat alteration, resulting from irrigation withdrawals that modify the hydrograph, disrupt sediment transport and distribution, and affect instream temperature, contribute to establishment of exotic species populations. In addition, portions of stream channels that were channelized and relocated on the floodplain no longer meander and have become entrenched. A long-term management goal for the Jenny Creek drainage should be to restore, to the extent possible, a flow regime that allows for natural fluvial geomorphic processes and provides habitats more favorable to native species. In addition, an inventory should be implemented to determine the current distribution and abundance of non-native aquatic and riparian species within the monument. Understanding where exotic species have become established, and the factors influencing their distribution, will improve our ability to restore habitats to minimize their impacts on native species.

Since land management activities occurring outside the monument (and on private lands within the boundaries) can affect ecological processes within the monument (and vice versa), it will be necessary to work closely with neighboring landowners and resource managers to minimize potential impacts. Again, the activities most likely to affect aquatic environments within the monument are those that alter flow regimes, sediment supply and temperatures of tributary streams. A program to monitor sites likely to be affected will be necessary to identify and correct impacts as they arise.

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Fire as an Object of Scientific Interest and Implications for Forest Management

by Evan Frost [1] and Dennis Odion [2]

Fire is a key process upon which a number of the monument's Objects of Scientific Interest directly or indirectly depend on and have evolved with. Fire is not mentioned directly in the Presidential Proclamation, but it is a process that is incorporated within definitions of ecological integrity: "a system's wholeness, including presence of all appropriate elements and occurrence of all processes at appropriate rates" (Angermeier and Karr 1994). We therefore review the historical pattern of fire in the monument landscape and point out the considerable uncertainty in what is known. A key theme is that our understanding of historical conditions, climate change and fuel dynamics has evolved rapidly recently.

Fire is also a key issue for the residents and their homes imbedded within the monument matrix. We discuss the critical issue of how to safeguard those interests by considering the subject of structure ignitions associated with wildfires. Our understanding of this subject has also improved dramatically quite recently. The focus of this discussion is on fire regimes in the monument's forests and the potential for influencing fire behavior and fuel loads through active intervention. Fire management issues related to chaparral and other shrublands are described in the section on chaparral and other shrubland vegetation.

I. Fire History and Fire Regimes

The complex terrain and vegetation patterns of CSNM and sharp environmental gradients make generalizations about historic fire regimes problematic. Further, based on reviews of the literature (USDI BLM 2000, 2002, Frost and Sweeney 2000), there appears to be very little information on fire regimes specific to the area of the monument. According to data presented in the BLM's draft management plan, there were 232 fires in the monument area from 1967-1999 (USDI BLM 2002, Map 23). Fifty five percent of these were caused by lightning. Unfortunately, the map does not indicate which fires are lightning-caused. Thus, it is impossible to determine where patterns of lightning ignitions are concentrated.

Since all lightning fires were suppressed before spreading significantly, it is unclear how much area would have burned in the absence of suppression. Lightning fires are often highly localized, even in the absence of suppression (Minnich et al. 2001), but they can also be extensive. Weather following ignitions and their proximity to the end of the fire season could provide some inference regarding potential spread, but it is not possible to infer much about fire regimes based on lightning ignition data. Agee (1993, fig. 2.1) reports that lightning is much less frequent in the area of the monument compared to areas east of the Cascades, suggesting the eastside may be an inappropriate reference.

There is scant information available regarding fire in the monument prior to 1967. We do know that fire is said to have been effectively suppressed since about 1950 (USDI BLM 2002), but apparently not prior to this. Minore (1978) describes fires occurring on the Plateau in 1910 and 1917. The earlier fire was 944 ha. The second fire (uncertain size) reburned part of the same

[1] Terrestrial Ecologist, Wildwood Environmental Consulting, Ashland, OR.

[2] Odion Botanical Consulting (Ashland, OR) and Marine Science Institute, University California-Santa Barbara.

area that was logged after the first fire. It is unclear the source of ignition for the two burns and how logging slash may have contributed to the reburn.

Fire frequency

Fire scar records from trees provide information on fire frequency in recent centuries in areas where trees are able to survive and record fires. Unfortunately, such dendrochronological data from the monument appear to be lacking, or have not been made available to the public. The DEIS (USDI 2002) does provide fire frequency estimates, but it is unclear what these are based on other than a paper on prescribed burning at Crater Lake National Park by Thomas and Agee (1986), which represents a significantly different situation from that of the monument.

In the absence of data from the general area of the monument, we can only evaluate fire frequency from nearby areas. These data exhibit considerable temporal variability in the number of rings between scars; the range is therefore more informative than the mean. As summarized in their review of fire history information for the Klamath-Siskiyou region, Frost and Sweeney (2000) report that fire return intervals in mixed conifer and white fir forests exhibit ranges of 6-116 years (central Siskiyous), 3-59 and 7-65 years (Klamath Mountains), and 2-56 and 4-71 years (southern Cascades). A 170 year absence of fire (from 14-16th centuries) was found in mixed conifer forests by Agee (1991), even though fire was common at other times at the Oregon Caves area he studied.

Interpretation of fire scar data as a basis for determining fire frequency requires more caution than previously recognized. Methodological problems and sources of error include: 1) sampled trees tend to be strongly biased toward those with the highest density of fire scars, 2) sampled trees may not be scarred by a particular fire, 3) scars may be a result of wounding unrelated to fire, 4) calculations of fire return interval often fail to include the interval between the pith (tree core) and first scar, and 5) inappropriately aggregating fire scar data to larger spatial scales (Agee 1993, Keeley and Stephenson 2000, Minnich et al. 2001, Baker and Ehle in press). Individually, each source of error or bias may not be great, however, when all error is combined it can be substantial.

Considering many of the abovementioned sources of error, Baker and Ehle (2001) found that mean fire return intervals reported for ponderosa pine forests of the western U.S. (2-25 years) have been significantly underestimated; their revised estimate was between 22 and 308 years. The fire frequencies reported for the Cascades and Klamath-Siskiyou region (as summarized above) may be similarly underestimated. The bottom line with regard to tree ring data is that in the absence of empirical evidence showing when past fires occurred on the monument landscape, it is difficult to say how the current fire-free interval compares with fire-free intervals of recent centuries. It follows that any fire-related management needs to explicitly acknowledge the relatively high level of uncertainty that currently exists.

Fire severity and spatial pattern

As in most of the Klamath-Siskiyou and southern Cascades, it appears that fire severity in the area of the monument was historically patchy and mixed. The majority of forests in the monument are intermediate between the dry interior forests to the east (where more frequent surface fires historically predominated) and upper montane/subalpine forests found at higher elevations (where fires were less frequent and stand-replacing). In a mixed-severity regime, fire may burn as a surface fire or a crown fire, or some combination of these, depending on weather, fuels and topography; the result is a variable patchwork of low, moderate and high severity effects. The patchiness has been instrumental in promoting the high species and habitat diversity that currently exists in the area encompassed by the monument.

There is very little data available on the spatial extent and landscape pattern of fire in mixed conifer and white forests of our region. Some careful inferences can be made from studies conducted in similar forests of the southern Cascades and Sierra Nevada. Over decades to centuries, the combination of numerous fire events of varying intensity resulted in a complex mosaic of mostly multi-aged forest stands across the landscape, with stands exhibiting a diversity of tree densities, ages and species (Taylor and Skinner 1998, Taylor and Skinner in press, Frost and Sweeney 2000). Fire played a role not only in shaping the overall landscape mosaic but also in creating a diversity of individual patch types that reflect variability in fire frequency and severity at the same site.

Unburned patches were often left within burned areas, where fuel profile was discontinuous, where fire burned during cool weather or due to other stochastic processes. Individual trees persisted to old age and large size within many different patch settings, ranging from dense near even-aged stands of old trees to scattered, even solitary old trees surrounded by shrublands or other non-forest vegetation. Some combinations of topography and aspect – particularly north- and east-facing slopes and valley bottoms – habitually escaped the effects of frequent fire and were more likely to support dense, multi-storied forest structures with abundant standing dead trees and logs (Taylor and Skinner 1998). High-severity fire behavior was strongly influenced by periods of drought and extreme weather (Agee 1997), which have been unprecedented in recent years (Whitlock et al. in press).

II. Influence of Euro-Americans on Fire Regimes

Euro-American settlement and land management activities occurring over the last century have resulted in significant changes to the monument's vegetation patterns and their associated fire regimes. Previous to the arrival of white settlers, Native Americans regularly applied fire to specific portions of the landscape and undoubtedly influenced vegetation patterns, at least on a local scale (Lewis 1990, 1993, LaLande and Pullen 1999). Although we are unable to separate the ecological influence of Native American fires from those resulting from lightning, the cessation of Indian burning practices was likely significant.

Fires ignited by early settlers (especially miners) during the latter half of the nineteenth century were dramatically different in terms of seasonality, intensity and extent from those previously set by Native Americans, and began moving vegetation patterns in a new trajectory (McKinley and Frank 1995). Fire regimes were also altered in places where livestock grazing reduced the fine fuels that facilitate the spread of fire. In addition to removing fine fuels, grazing exposed mineral soil, which facilitates the establishment of conifers over perennial grasses and other herbaceous plants (Belsky and Blumenthal 1997).

Over the last half-century, fire suppression and past timber management have been the two most important agents of landscape change. Selective logging removed many of the large, fire-resistant trees and often increased fire hazard by generating large volumes of surface fuels (i.e. logging slash). Dispersed clearcutting, which began in the monument after World War II, has converted many hectares of late-successional/old-growth forests into tree plantations, which are generally more susceptible to fire and often contain higher levels of surface fuels than unmanaged older forests (Weatherspoon 1996, Sapsis and Brandow 1997). In addition, the extensive network of roads constructed to facilitate logging has increased the likelihood of human-caused fire ignitions during hot, dry conditions (USDA Forest Service 2000). Taken together, past timber management activities have increased the susceptibility of the monument's forests to severe fire (Perry 1995).

The result of fire suppression and logging is that forests within the monument generally support higher densities of young, fire-susceptible trees (e.g. white fir), contain more available live and dead fuels, and are prone to larger, more severe wildfires than they were historically. Stand-replacing crown fires now pose threats to soil productivity, the persistence of sensitive wildlife species and watershed integrity. Natural forest openings, once characteristic of monument landscapes, have probably shrunk in size due to tree encroachment (Skinner 1995). Some of the landscape heterogeneity previously created by fire has been reduced, and some species that are dependent on fire have probably decreased in abundance (Brown and Smith 2000).

It is important to recognize that the effects of past management activities on fire behavior and vegetation have not been temporally or spatially uniform. Some areas of the monument are likely outside the natural range of variability in terms of fuel loadings, stand structures and other ecological attributes, whereas others have changed relatively little (Frost and Sweeney 2000). In general, changes are likely to be most dramatic in areas where fire suppression actions and past logging have been concentrated and in the drier ecosystem types (e.g. oak/pine and mixed conifer zones) where fire-free intervals were historically short. Any restoration strategy must recognize these differences and target efforts in those areas that are most likely to benefit from active management.

III. Treatments to Reduce Fire Severity and Manage Fire-dependent Forests

The DEIS recommends landscape-level treatments, including commercial timber harvest to reduce the severity of future fire. The proclamation language allows commercial timber harvest "when part of an authorized science-based ecological restoration project aimed at meeting protection and old-growth enhancement objectives." If carefully planned and implemented from an ecological perspective, thinning [3] has the potential to reduce the probability of crown fire and create stand structures that facilitate the reintroduction of fire (Agee 1996, Graham et al. 1999). However, currently there is very little empirical research concerning the efficacy of and risks involved with using thinning for restoring forest ecosystems, particularly with respect to the monument's Objects of Scientific Interest.

Although our current understanding of the ecological effects of thinning is incomplete, available evidence indicates that mechanical treatments can have persistent, adverse impacts (see mixed conifer section for more detailed discussion of this topic). The need for reducing fuels and altering stand structure must be carefully weighed against the risks of undesirable effects associated with the mechanical treatments themselves. We believe the key to using thinning as a fire/forest restoration tool is to experiment with the practice in those areas where it is most likely to facilitate the development of more natural forest conditions without exacerbating existing problems or creating new ones (Perry 1995).

The other primary tool available for restoring forest structure and process is prescribed fire, defined here as fires that are either intentionally ignited or natural ignitions that are allowed to burn according to pre-established guidelines of behavior, with a clear plan for containment or control (Martin 1990). In those areas where it can be safely applied, prescribed fire has several advantages over thinning as a restoration tool. It is generally more effective and often less costly

[3] The term thinning as used in this discussion refers to "understory thinning", "thinning from below" or "low thinning" to describe the cutting and removal of mostly small-diameter trees from below the forest canopy.

for reducing surface fuels (e.g. litter and woody debris), returns fire as a key ecosystem process, and is the best way to align forest conditions with current and future climatic conditions (Martin et al. 1989, Norris 1990). However, the application of prescribed fire is challenging and may be too imprecise or unsafe in many settings (e.g. wildland/urban intermix areas, areas with high fuel loads). Concerns about excessive smoke and the risk of escapes (highlighted by the Cerro Grande Fire of 2000) have also reduced public support for the use of fire alone as a restoration treatment.

Both thinning and prescribed fire are potentially legitimate tools for forest restoration – each has its own set of risks and limitations. While thinning may be successfully used to reduce future fire severity, it cannot replicate many of the important ecological effects of fire. Management approaches that focus on structural manipulation – as have been proposed in the BLM's DEIS for the CSNM – are therefore unlikely to meet ecological objectives, unless they are combined with fire. Prescribed fires may be sufficient to re-establish natural conditions in locations where forest structures have not been dramatically altered from historic conditions and in areas supporting high ecological values and/or high sensitivity to disturbance (e.g. key watersheds, steep slopes, fragile soils).

To maintain ecological integrity over the long term, we believe management of the monument must emphasize the return of fire as a key ecosystem process rather than manipulating vegetation to emulate historical stand and landscape structures (Smith et al. 1993, Agee 1995, Bunting 1996, Crow and Gustafson 1997, Keifer et al. 2000). Some forests that have been dramatically altered by past management will need structural manipulation via thinning or other fuel treatments before fire can be safely reintroduced. Once some degree of structural restoration is achieved and the risk of uncharacteristically severe fires is reduced, then fires can be managed to shape future vegetation patterns that conserve native biodiversity and are in alignment with current climate (Parsons et al. 1986, Bell et al. 1997, Stephenson 1999).

IV. Safeguarding Residential Structures from Wildfire

Wildfire occurring on the monument is a serious threat to the many structures presently imbedded in the landscape in the checkerboard ownership areas, and on the periphery. Based on studies by Cohen (2000, and oral presentation 2002), wood structures do not ignite from the radiant and convective heat of fire from burning vegetation, including high intensity crown fire, when that combustion is occurring more than 33 meters (100 feet) from structures. The bulk of structural ignitions associated with wildfires are the result of firebrands igniting combustible parts of homes or fuels in their immediate vicinity that connect to combustible parts of structures. Often the firebrand ignition of structures is delayed so that it occurs after wildfire has passed through the area, but it is not prevented because there is no one around. Such ignition patterns explain why many homes burn up completely while much of the vegetation surrounding them remains unburned.

In order to prevent structure ignition from wildfires, it is necessary to prevent the possibility of ignition from radiant and convective heat from vegetation within 33 meters (100 feet) of structures, as well as ignition from firebrands. This means that the immediate vicinity of the structure, the home ignition zone, must be maintained as an intensive fuel management area not capable of supporting high rates of radiant and convective heat flux when burned. Secondly, firebrand production in wildfires is inevitable, and is particularly common in conifer vegetation. Therefore, available fuel ignitable by firebrands, including fuels that burn slowly by smoldering combustion, must not connect to an ignitable portion of the structure. Finally, and most importantly, structures must be able to withstand firebrands impinging directly upon them.

Any approach to preventing structure ignition from wildfire that does not remove one of the three requirements for combustion, heat (ignition energy or source), oxygen, and fuel, will be imperfect. Only the latter can be controlled. Eliminating this requirement for combustion to deny wildfire's ability to ignite structures can call for costly home improvements and vegetation removal that is excessive enough that it may be considered by many to be undesirable for aesthetic reasons. However, these investments are the only ones guaranteed to pay dividends. Alternatively, if homeowners prefer conditions in the home ignition zone that pose a fire threat, there is no way society can ensure that they are protected, and they must recognize the potential consequences and take the appropriate actions to insure their valuables and personal safety.

Where actions are limited by expense, creative solutions are needed. Most actions are needed on private land because treating areas beyond 33 meters from structures does not address the problem of structure ignition, unless these treatments could eliminate fire entirely from the surrounding landscape (untenable), or unless they create defensible space for suppression forces. Unfortunately, suppression forces are not available to defend many structures during wildfires. Therefore, effective solutions involve private property and the actions described above. Realistically, government assistance and/or incentives to homeowners may be required to tangibly reduce the threat of wildfires to homes, and the structures themselves must be a main target in order to realize benefits from public expenditures.

V. Management Recommendations

In this section we recommend a set of general principles that can be used to guide the design and implementation of fire management and ecological restoration activities on forests in the CSNM. The principles presented here are necessarily general in nature. Development of "one size fits all" treatments and prescriptions is not possible because of the high degree of variability in pattern, process, composition and structure, and the varying degrees of departure from historic conditions resulting from past human activities. We do not consider these ten principles an exhaustive list, but we believe that these factors should be carefully considered in the design and implementation of any fire/forest restoration project in the monument.

1. Develop a fire management plan for the monument. Planning for the suppression of future fires is needed to minimize damage as a result of suppression activities. This damage is often considerable, so BLM and the Oregon Department of Forestry should develop a fire management plan that outlines suppression strategies that minimize undesirable ecological effects. All fire suppression efforts should emphasize "light hand" tactics (Moody and Mohr 1991) that avoid riparian areas, steep slopes, roadless areas, late-successional forests and other key habitat areas (Beschta et al. 1995). Wildfire management planning should be coordinated with prescribed fire plans and activities to optimize the efforts of each fire management component.

In addition, policies should be developed to reduce the number and density of human structures within areas with high potential for wildfires. Efforts should be made to educate the public about landowner risks and responsibilities in this fire-dominated landscape. Protect existing structures by finding creative solutions to intensive management of fuels in the home ignition zone, and most importantly by fire-proofing homes. Create additional defensible space by clearing vegetation in interface areas where suppression forces will likely use them based on fire planning as described in previous recommendation. Do not undertake treatments more distant from structures in lieu of treating the known causes of home ignition described earlier. These procedures should greatly reduce actual existing hazards to residents and their structures and allow for better accommodation of fire on the remainder of the landscape.

2. Develop fire/forest restoration plans at the landscape scale. Ecologically sound restoration planning requires a landscape focus (e.g. scale of 6^{th} field watersheds or larger) that considers all proposed actions in a larger spatial and temporal framework. Spatially explicit watershed- or landscape-level assessments, including analysis of current and historical conditions, fire hazard and risk, watershed integrity, habitat available for at-risk species, and other variables, are necessary to identify restoration priorities and should be conducted before widespread fire or fuel reduction treatments are initiated. Approaches that consider only a subset of these issues or fail to analyze the various risks and tradeoffs in an interdisciplinary, spatially explicit fashion will not be adequate.

3. Prioritize restoration treatments to maximize ecological benefits and minimize risks. Effective restoration will require a clearly defined strategy for landscape prioritization that targets activities in areas where they are most likely to generate immediate restoration gains with the least possible risk to water quality, soils, wildlife, and other ecological values. Key considerations for prioritizing restoration treatment areas include:

- the degree of departure of forest structure and composition from historic reference conditions, with emphasis placed on forest types characterized by relatively frequent, low and mixed severity fire regimes.
- the location of critical habitats, including late-successional/old-growth forests, key watersheds, habitat for sensitive, threatened and endangered species, and other declining or unique elements of biodiversity.
- fire hazard (a function of fuel load, continuity, topography) and fire risk (historic fire occurrence, ignition patterns), which can be used to evaluate future fire severity and the risk of loss due to wildfire.
- strategic positioning to break up landscape-scale continuity of fuels prone to high severity effects, building upon natural fuelbreaks wherever possible.
- landscape context and adjacency considerations.

Identifying those areas with high ecological value (e.g. key habitats) that are at high risk of loss provides an appropriate framework for prioritizing restoration where it is most likely to yield improved conditions. By working strategically in this way it may be possible to establish mosaics of fuels and forest conditions that reduce the risk of unnaturally severe fires without imposing undue risk to currently important habitats and remaining high-integrity areas.

4. Protect areas with high ecological integrity. Some areas within the monument have been relatively little disturbed by intensive management practices (e.g. the “Diversity Emphasis Area” in the southern half of the monument) and may still closely resemble near-natural or historic conditions. While generalizations are difficult, high integrity landscapes tend to be associated unroaded or lightly roaded areas and late-successional/old-growth forests. These areas serve as cornerstones for any future restoration efforts, and they provide benchmarks for defining ecological processes and structures that restoration should emulate in more degraded areas (Noss and Scott 1997, DellaSala and Frost 2001).

5. Restore fire as a key ecological process. Since fire is an essential component in the dynamics, resiliency, and sustainability of forest ecosystems in the monument, prescribed fire should be considered as the preferred tool in reducing fire hazard and creating more open stand structures. Reintroduction of fire is the single most important management action to restore ecological integrity because it recreates the natural, dynamic interaction between ecosystem structure and process (Allen et al. in press). Although prescribed fire is the most valuable tool for restoring ecological process, the application of fire is quite challenging.

It takes considerable experience and knowledge to implement a burn that is safe and successfully achieves ecological objectives (Kilgore and Curtis 1987, Biswell 1989). The use of management-ignited prescribed fire requires detailed, site-specific planning, adequate budgetary support and careful execution by trained personnel, which are often in short supply (Husari and McKelvey 1996, Parsons 1995). Air quality regulations and public resistance also have the potential to seriously limit land management actions that use fire for restoration (Shelby and Speaker 1990). Cooperation between air regulatory agencies, land managers and the public will be essential if fire is to be used as a viable restoration tool.

Undertake prescribed burning during the normal fire season whenever feasible. Spring burning is generally discouraged because of potential damage to soil organisms, depletion of water retention in soils before the summer season, and threats to vulnerable birds and burrowing mammals. Monitor fire effects. If empirical data demonstrate that severity is unnaturally high compared to the past, based on patterns discerned from stand structure data, proceed with fuel treatments described below and in the mixed conifer section. If fire effects are not heterogeneous and patchy and do not create gaps for regeneration of shade intolerant pines, restore fire that has these natural effects.

6. Experiment with mechanical treatments that facilitate the reintroduction of fire. Fire alone cannot always be used to re-establish desired vegetation characteristics or disturbance regimes. In many situations, the increase in surface and live ladder fuels has created conditions that will be difficult or impossible to burn safely and produce desired outcomes. In areas where hazardous fuels are too high, some type of mechanical treatment will be needed before fire can be safely reintroduced. However, because mechanical treatments cannot adequately substitute for the many ecological effects of fire, approaches that rely solely on manipulating forest structure without a long-term commitment to also restore fire as a keystone process are inappropriate for the CSNM.

Decisions about the use of mechanical treatments must be based on local conditions and a detailed analysis of short-term impacts, long-term benefits, the multitude of risks involved, and the likelihood of accomplishing restoration objectives. It is clear, however, that mechanical treatments will be most appropriate in areas where: 1) forest structures have been altered to the point where reintroduction of fire is likely to be detrimental, and 2) the risks of adverse environmental impacts associated with thinning are minimal.

Given the potential for serious adverse ecological impacts, many scientists have indicated that previously logged areas are the highest priority for thinning and other treatments, at least until th presumed benefits of these actions can be better documented (Henjum et al. 1994, Perry 1994). We recommend mechanical thinning should be focused within previously managed and roaded portions of the monument, particularly tree plantations and areas previously logged through partial overstory removal. Within these areas, we make the following recommendations:

- Focus on removal of excess numbers of small, suppressed and intermediate trees (e.g. generally less than 30 cm (12 inches) in diameter or less than 50 years old), particularly of fire-sensitive species that have become more abundant as a result of fire suppression and past logging (e.g. white fir). However, given the heterogeneous and dynamic nature of these forests, removal of all or even most fire-sensitive trees is inappropriate. Tree removal should be based on ecological criteria, with the twin goals of reducing the hazard of stand-replacing fires and opening prescription windows such that fire can subsequently be more safely applied.

- Protect all large and old trees. Removing large trees (generally greater than 43 cm or 17 inches dbh) is not justifiable as a part of forest restoration efforts. These trees are the most resistant to fire, play numerous important ecological roles, are difficult to replace and occur at much lower levels across the landscape than they did historically (Beardsley and Warbington 1996). Ecologically-based prescriptions will also retain all other existing components of the forest's structural diversity, including trees with atypical crown architecture, snags, hardwoods, understory vegetation and down logs.

- Retain at least 20% or more (depending on site-specific wildlife habitat needs) of an area considered for treatment in an unthinned condition. Retention of some dense areas provides important structural diversity, wildlife cover, and undisturbed soil/understory conditions within managed stands. The exact percentage and location of untreated areas should be determined on a site-specific basis to maximize their effectiveness in meeting ecological objectives.

- Utilize existing road systems and landings. No new permanent or temporary roads should be constructed to facilitate silvicultural thinning operations. Analysis associated with potential thinning projects should, to the extent possible, determine the need for closure of roads that pose a threat to ecosystem integrity or that increase the risk of human-caused ignitions (Gucinski et al. 2001, Luce et al. 2001).

- Reduce slash and other surface fuels generated as a result of mechanical treatments. Accumulations of tree branches resulting from thinning and other silvicultural activities will increase fire hazard if they are not reduced (van Wagtendonk 1996, Weatherspoon 1996, Stephens 1998). Wherever feasible, surface fuels should be reduced with prescribed fire rather than machine crushing or piling, which are more likely to result in adverse effects (Windell et al. 2000).

- Analyze cumulative effects. Restoration thinning projects will occur within landscapes where numerous other management activities, such as private land developments and livestock grazing, may also take place. In order to avoid undesirable cumulative effects with these other actions, restoration treatments may need to incorporate spatial constraints or be implemented incrementally over time (George and Zack in press).

- Protect ecologically sensitive areas, including areas with highly erosive or unstable soils, steep slopes riparian areas, hardwood stands and other rare/unique communities. These sites are often local hotspots of biodiversity and are more likely to be adversely affected by mechanical treatments.

- Ensure that guidelines for protection of soil integrity are met by employing low-impact silvicultural systems that minimize compaction and disturbance of the soil surface organic layer. Cumulative impacts of soil compaction, disturbance and puddling should be kept to less than 10% of an activity area. Monitoring is necessary to ensure that these standards are met (Jurgensen et al. 1997, Page-Dumbrose et al. 2000).

7. Manage for naturally high levels of heterogeneity. The forests of southern Oregon, including those within the monument, are notoriously heterogeneous – stands of differing structure, age, species composition, and fire regimes are often intermixed with one another, and conditions change dramatically across very short distances. Ecological restoration requires an understanding and appreciation of these naturally high levels of heterogeneity – in both structure and process – that exist and multiple spatial scales. For example, tree density, species composition, and other key attributes range widely between different forest associations that are found in the monument.

The important point is that not all forests nor individual stands are the same, nor will they require the same restoration treatments. An understanding of historical-ecological conditions at the *local* level is important to determine the natural range of variability for key attributes that can serve as general guides (but not rigid goals) for restoration design in particular landscapes. Ecologically-based strategies will manage for naturally high levels of heterogeneity and avoid creating uniform forest conditions, even at the stand scale. For example, prescribed fires should be designed to incorporate the variability in return interval, timing, intensity and severity inherent in historic wildland fires. No single technique or treatment should be widely applied in a uniform fashion.

8. Implement multiple, conservative treatments. Despite recognition of the need to restore integrity and resiliency to fire-dependent forests, surprisingly little is known about the short- and long-term effects of active restoration treatments, the conditions under which various approaches will produce desirable outcomes, or even appropriate forest reference conditions. Moreover, the BLM has little practical experience in implementing active restoration treatments, particularly at the landscape scale. Until the efficacy of new and promising approaches can be demonstrated, we believe that it is prudent and preferable to experiment with restoration incrementally over time. Projects need to proceed cautiously, taking care to cause the minimum damage to the ecosystem while moving the forest toward a condition in which ecological processes can function naturally.

In those landscapes where important ecological values are threatened by unnatural crown fires, initial restoration should involve the minimum and least disruptive actions necessary to reduce this threat, and occur outside of areas with high ecological value. Where substantial alterations are required, managers should consider the benefits of staggering several sequential treatments over time to achieve restoration objectives. This type of patient, incremental approach will maintain future management options, allow for the development of needed skills and experience, and provide important opportunities to adjust restoration treatments based on new information as it becomes available.

9. Integrate restoration projects with species-level conservation goals. Restoration treatments that result in substantial changes to the structure, composition and patterning of vegetation will have both short- and long-term effects on wildlife. Many species will immediately benefit from restoration treatments, but some, including those that depend on dead wood and closed-canopy forest conditions, may be adversely affected (Tiedeman et al. 1997, Bull et al. 1997). The biota of the monument's forests has generally evolved with fire, but the cumulative loss and degradation of habitat resulting from human activities (principally logging and fire suppression) have drastically reduced populations of some species to the point where any additional decline may threaten their continued persistence (see other sections, this document). It follows that restoration strategies should, to the extent possible, avoid adverse impacts and minimize risks to at-risk species, both spatially and temporally.

In order to avoid adverse impacts, surveys for rare, sensitive, threatened and endangered species should be conducted before any ground-disturbing activities take place. Particular attention should be directed at plants, lichens, fungi, mollusks, amphibians, butterflies and other taxa that may be adversely affected. We suspect that a large proportion of high-priority restoration opportunities can be implemented without affecting habitat for wildlife of special concern. In those cases where potential conflicts exist, a detailed risk analysis should be completed prior to treating any areas that serve as important habitat.

10. Incorporate research, monitoring and adaptive management as essential elements of restoration efforts. As stated previously in this section, there are substantial areas of uncertainty – both in theory and practice – surrounding the restoration of fire-dependent ecosystems. We have a great deal to learn about ecosystem conditions (both historical and contemporary), the ecological effects of various restoration treatments and how they can be most effectively implemented to produce desired outcomes. Thus, well-designed monitoring and evaluation programs must be built into all restoration efforts so that we can learn as we go along. Monitoring should evaluate a wide array of ecosystem components and be coordinated amongst the disciplines and personnel involved.

While much can be gained from a well-designed program of monitoring, additional scientific research is also necessary. Where possible, projects should be designed as experiments with replicates and controls to test alternative hypotheses (Sexton and Czaro 1999, Michener 1997). New understanding resulting from these efforts should then be used adjust subsequent restoration activities, enabling an adaptive management approach (Walters and Holling 1990). A sustained institutional and budgetary commitment to these activities will be essential if measurable progress is to be made towards achieving long-term restoration objectives.

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The Importance of Landscape Connectivity for Protecting The Monument as a Biological Crossroads.

by Dominick A. DellaSala [1]

GIS mapping and forest change detection analysis conducted by Gerald Heilman and Jim Strittholt, Conservation Biology Institute, Corvallis.

I. The Monument as a Biological Crossroads and Landscape Connectivity

The Cascade-Siskiyou National Monument (CSNM) is a high-elevation land bridge of regional and national significance (see proclamation language). The importance of the monument as a "biological crossroads" has been recognized by federal agencies through the Northwest Forest Plan (ROD 1994 p. 30) and in the planning of the Cascade-Siskiyou Ecological Emphasis Area (USDI BLM 2000) that preceded the monument's designation. Atzet (1995) recognized the Siskiyou Crest-Greensprings area (which includes the CSNM) as "one of the more important intersections in the Northwest." According to Atzet, the Siskiyous form the crossbar of an "H" across a continuous high-elevation ridge system linking the Cascades to the Coast Range – the Pilot Rock area is a "hinge-point" or connection point.

The Siskiyou Pass also has been referred to as "essential for California lowland species to migrate into the Rogue Valley when temperatures are high and as a migratory pathway for four mountain provinces" (Axelrod and Detling cited in a March 3 1994 letter from T. Atzet to Dave Willis on file with the Soda Mountain Wilderness Council). Atzet further states that "the Soda Mountain area is more than just botanically interesting, it is an important link for migration, dispersion, and the process of evolution in the Northwest." Researchers such as Strittholt et al. (1999), Noss et al. (1999), and DellaSala et al. (1999) have identified the Siskiyou Crest area, including the monument, as an important terrestrial linkage for the dispersal of wildlife across the Cascade-Siskiyou land bridge.

Key to the management of the monument's crossroads function is the recognition that landscape connectivity is essential to maintaining the monument's integrity. Notably, the 9th Circuit provided legal precedence for the recognition of biological corridors by holding that an agency's environmental analysis of a project must consider the impacts of the project on the area's values as a biological corridor (Marble Mountains Audubon Society et al. v. Rice, 914 F.2d 179, 9th Cir. 1990). Further, management of connectivity has been recognized by federal agencies through the Thomas et al. (1990) report on spotted owls, which spatially positioned Late-Successional Reserves to minimize travel distances primarily for dispersing young owls. Thus, we believe it is central to the monument's crossroads function that BLM recognize that sufficient protection, maintenance, and restoration of *landscape-level connectivity* is inherent to the integrity of the monument. It follows that connectivity needs to be recognized as an Object of Scientific Interest in the monument's management plan.

This section examines the monument's strategic and unique connectivity functions and makes a compelling case for treating connectivity as an object of interest necessary for maintaining its biological crossroads function by:

[1] Program Director, World Wildlife Fund, Klamath-Siskiyou Regional Program, Ashland, OR.

(1) documenting the importance of the connectivity and reasons for treating it as an object of interest;
(2) describing the status and condition of connectivity both in the monument and its surroundings (5-, and 10-mile radius of public and private lands);
(3) recommending focal species or assemblages that can be used to represent and maintain connectivity; and
(4) providing specific management and monitoring recommendations for protecting, maintaining, and restoring functional connectivity in this landscape.

II. Importance of Terrestrial Connectivity as an Object of Interest

Managing for functional connectivity at the landscape level is fundamental to the maintenance of viable populations, particularly species distributed as metapopulations (Harrison 1991). Connectivity is essentially the opposite of habitat fragmentation and exists in landscapes where there is a high potential for the movement and genetic exchange of wildlife populations (Noss 1991, Noss and Cooperrider 1994, Bennett 1999). It involves linkages of habitats, species, communities, and ecological processes at multiple spatial and temporal scales (Noss 1991). Ideally, multiple corridors acting collectively as connectivity networks are recommended to encompass the full range of habitat types, particularly those positioned along elevation or environmental gradients (Noss and Cooperrider 1994, Bennett 1999).

Many factors determine the degree of functional connectivity at the landscape level, including: (1) the mobility or dispersal characteristics of a species of concern (i.e, focal or target species); (2) autecological characteristics of the focal species; (3) landscape context (structural characteristics and spatial patterns); (4) distance between patches of suitable habitat; (5) presence of barriers to movements (e.g., roads, clearcuts); and (6) interference from humans (Noss and Cooperrider 1994, Bennett 1999).

Functional connectivity is important for species ranging from the northern spotted owl (*Strix occidentalis caurina*, Thomas et al. 1990) to range- restricted endemics and small isolated populations (Noss and Cooperrider 1994, Bennett 1999). For the spotted owl, Thomas et al. (1990) defined connectivity as "a measure of the extent to which intervening habitat truly connects blocks of suitable habitat to allow individuals of the species in questions, usually juveniles, to disperse between them." Connectivity is affected more by the suitability of the overall landscape to either a focal species (e.g., like the owl) or targeted assemblage having common migratory or dispersal requirements than by the presence of discrete corridors (also see Thomas et al. 1990 and Bennett 1999). In fact, narrow corridors may facilitate the spread of diseases (Noss 1991, Bennett 1999) and can act as "ecological traps" for species that breed within them because of elevated predation and brood-parasitism associated with forest edges (Wilcove 1985).

Managing for functional connectivity can be achieved through the use of landscape linkages, particularly if they contain suitable dwelling habitat and conduits for species dispersal (see Special Feature in *Conservation Biology* 1996 on large carnivore dispersal in relation to landscape linkages). Landscape linkages include a broad array of habitats that provide major links at the landscape or regional level (Bennett 1999). In order to minimize edge effects, however, linkages must be wide enough to capture an adequate amount of core habitat.

A general rule is for the width of the linkage to exceed the average dispersal distances of the focal species (Noss and Cooperrider 1994, Bennett 1999), which in many cases has been modeled using large carnivores (cougar *Felis concolor*, wolverine *Gulo gulo*, grizzly bear *Ursus* *arctos*, gray wolf *Canis lupus*- see Noss et al. 1996, *Conservation Biology* 1996, 2000, Carroll et al. 2001) and other forest dwelling carnivores (e.g., northern spotted owl, Pacific fisher *Martes pennanti*, marten *M. americana*, lynx *F. lynx* – FEMAT 1993, Ruggiero et al. 1994, Noss et al. 1999). Alternatively, large core reserves could be positioned close enough to each other as part of a reserve network to minimize the need for wide linkages. Core reserves separated more than dispersal distances of the target species, however, should contain resident individuals or populations, either distributed continuously or in stepping stone habitats necessary to facilitate genetic exchange and prevent genetic isolation and population "bottlenecking" effects (Noss and Cooperrider 1994, Bennett 1999).

The Northwest Forest Plan is a good example of maintaining functional connectivity for a focal species, the northern spotted owl, with reserves spaced 11-19 km (7-12 miles; 7 miles in the Oregon Cascades). However, such distances may not be adequate for range restricted species, particularly in places with high levels of endemism – like the Klamath-Siskiyou ecoregion – or with concentrations of range restricted plants and mollusks – like the monument. Thus, connectivity should be based on the requirements of a representative cross-section of focal species or species assemblages and should be managed to limit gaps that act as barriers to dispersal (i.e., roads, clearcuts, development; Bennett 1999). The key to functional connectivity is to therefore to reduce fragmentation from human activities, thereby making the landscape permeable to dispersal of the target species. The intent of connectivity management should be to produce a well-connected mosaic of habitats across the landscape that facilitate the movement of a representative array of focal species and assemblages. Numerous publications in the landscape ecology and conservation biology literature support this approach (see Bennett 1999 for a comprehensive review).

It should be noted that while the monument also has been referred to as a "convergence zone" for plants of distant physiographic provinces (USDI BLM 2000), this related function does not diminish the importance of maintaining connectivity through reserve networking or linkage zone management. Consequently, more emphasis by the BLM needs to be placed on maintaining functional connectivity (not just the convergence zone or biological crossroads concept) for the dispersal of key objects of interest and targeted assemblages through the specific management and monitoring recommendations described below.

Finally, we note that had the monument boundaries been drawn purely on ecological grounds much more public land would have been incorporated for connectivity and core area functions, particularly the public forests west of the monument boundary (north of Highway 66) and public lands from the California border south to the Klamath River (including Horseshoe Wildlife Area and BLM lands dispersed along the Klamath River canyon). Leaving these lands out of the monument has fragmented connectivity, presenting jurisdictional challenges to BLM. In addition, the monument is already small by reserve standards and in the context of the surrounding landscape presents long-term challenges for the maintenance of population viability of the monument's ecological values. This may be especially true given that much larger protected areas (e.g. Yellowstone National Park) have experienced local extirpations due largely to inhospitable conditions on adjacent lands (Newmark 1985).

III. Status and Condition of Terrestrial Connectivity in the Monument

This section provides an overview of the current and past conditions of private and federal lands within a 5- and 10-mile radius surrounding the monument, using methods described in Staus et al. (in press). These researchers used remote sensing (TM imagery) and GIS analysis dating back to 1972 to monitor the rate of fragmentation from road building and logging within the Klamath-Siskiyou ecoregion, including the monument. The analysis that follows describes these results as they pertain to the monument and as extracted from data sets analyzed by Staus et al. (in press).

In general, remote sensing techniques indicate that the monument has at least three primary connectivity features: (1) topographic; (2) land or vegetation cover; and (3) land use designation. The monument's topographic connectivity can be clearly seen in Figures 1 and 2 (different scales), particularly the high elevation (light brown) bands spanning from northeast (north of Howard Prairie) to the southwest (through Pilot Rock) into the Mt. Ashland area to the west. Connectivity of high elevation areas is important for species like the wolverine and many migratory bird species [2]. This topographic feature of connectivity is consistent with Atzet's account of the migratory and dispersal features of the Siskiyou crossroads.

Land cover is another important indicator of the connectivity function of the monument. At a coaurse scale, the monument provides an important linkage for mature and old-growth forests especially when considering landscape context and conditions in the surrounding area (Figures 3 and 4). At this scale, continuity of late-seral forests is most apparent from the northeast (Howard Prairie area) to the southwest and into the surrounding late-seral forests connecting up with the Mt. Ashland Late-Successional Reserve. This particular area of late-seral continuity is likely important to juvenile owls dispersing across the Siskiyous and southern Cascades and overlaps with known owl areas identified by Thomas et al. (1990). Notably, I-5 and Highway 66 show up as distinct barriers to dispersal and as population sinks for dispersing wildlife (e.g., deer, elk, cougar) due to road mortality. Highways and roads have been identified as a major barrier to wildlife in mountainous regions across the West (see Special Features in *Conservation Biology* 1996, 2001) and have been mitigated in some instances through the use of highway under- and over-passes.

The southern portion of the monument also appears continuous (at this coarse scale) for other land cover types (e.g., broadleaf, oak woodland) and can serve as an important linkage for associated assemblages (Figures 3-4). The extreme southern portion of the monument and, in particular, the Horseshoe Wildlife Area, appears as an important connectivity or linkage area joining related cover types within and adjacent to the monument (Figures 3-5). Consistent with the mapping results, the Oregon Department of Fish and Wildlife has identified the Horseshoe Wildlife Area as an important seasonal corridor for wintering mule deer. Further research is needed to identify the area's role as a dispersal or migratory corridor to the Klamath River canyon for other important wildlife such as the endangered willow flycatcher (*Empidonax traillii*) and peregrine falcon (*Falco peregrinus*).

Given the differences in management objectives across jurisdictions, land designation is more of an indicator of fragmentation than it is of connectivity. Figures 5 and 6 illustrate the checkerboard nature of BLM and private lands within the monument boundary especially north of Highway 66) and outside to the north (Howard Prairie area), west and south of Mt. Ashland where the checkerboard prominently stands out. Where such lands are relatively unroaded and of similar cover classes (i.e., reduced fragmentation), they may facilitate the land bridge function of

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[2] Confirmed wolverine den sites have been reported near Mt. McLoughlin to the northeast – well within the dispersal distance of wolverine – see DellaSala et al. 1999; also many birds and some bats are known to migrate along ridge lines (e.g., birds of prey) and other species migrate up and down elevation bands seasonally.

the monument, particularly if they are managed in compatible ways (e.g., as late-successional reserves, private lands acquired from willing sellers, Horseshoe Wildlife Area).

Having identified the connectivity function of the monument spatially, the remaining figures (7-8) document cumulative impacts to connectivity within and adjacent to the monument over nearly a three-decade period (1972-2000) for which TM imagery is readily available. These can be generally grouped as:

- fragmented jurisdictions within and adjacent to the monument (as described above and in Figures 5 and 6);
- an extensive network of roads within and adjacent to the monument (Figures 7 and 8); and
- a substantial amount of industrial scale logging within and adjacent to the monument (Figures 7-8).

Roads

There are 470 miles of roads (all ownerships) crisscrossing the monument (BLM DEIS 2002), particularly north of Highway 66 (Figure 7). In general, road densities varied little within the monument or its surroundings on public or private lands, ranging from 3.4-4.0 mi/mi^2 (Table 1). Road density estimates likewise were similar on California lands within the buffer zones. We note that roads have been identified as a major factor involved in habitat fragmentation (*Conservation Biology* 2001 special feature on roads). Densities greater than 1 mi/mile^2 have been reported in the literature as associated with the decline of ungulates, large carnivores and salmonids (see Noss et al. 1996, Trombulak and Frissell 1999, *Conservation Biology* 1996, 2001, PRC 2002, Heilman et al. 2002, Stauss et al. in press for reviews). The monument and its surroundings therefore are three to four times above what is considered to be a theoretical threshold for aquatic and terrestrial connectivity.

Logging and Changes in Forest Cover

The results of the TM imagery assessment and related GIS mapping of forest cover and forest change detection analysis in the monument are a reasonable approximation of logging rates while accounting for forest regrowth. We note, however, that some numbers in Table 2 reflect positive changes in forest cover despite the presence of logging (e.g., 1982-92 – change rates in the monument). This positive change can be accounted for either by forest recovery that exceeds logging during that particular decade, or are an artifact of applying a coarse sensor over a relatively small area of the monument. This error is less likely over larger areas such as the buffers.

The monument contains about 45,762 acres of public lands forest and another 28,683 acres of private lands forest, corresponding to approximately 87% of the land cover types in the monument (Table 2). Most of these forests are of the mixed conifer forest type described in the related chapter in this document. The remainder is hardwoodlands and broadleaf forests, based on TM imagery classifications (also see Figures 3-4).

Public Lands **-** Logging resulted in a decline of approximately 3,466 acres (7.6%) over the 28-year period within the monument (Table 2). This corresponds to an annual rate of about 0.3% over the time period. In general, logging rates were lowest from 1982-92 and highest from 1992-2000; however, a ten-year timber harvest deferment was put into effect by the BLM within the

Cascade-Siskiyou Ecological Emphasis Area in 1995, meaning that most of the logging was in the early part of that decade. Logging levels on public lands within the 5- and 10-mile buffers resulted in a decline of 3.6%-4.6% of total forest cover, an annual rate of 0.1% to 0.2%.

Private Lands - Logging resulted in a decline of approximately 8,536 acres (30%) or 1.1% annually over the 28-year period within the monument; approximately seven times the annual rate on public lands within the monument (Table 2). Logging levels were lowest from 1982-92 and highest in the last decade. Logging on private lands within the two buffers resulted in a decline of 12.9%-15.7% of the total forest cover, an annual rate of 0.5%-0.6%, which is three to five times higher than the comparable buffers on public lands.

Public and Private Lands – Logging resulted in a total decline of approximately 11,750 acres (15.8%), 0.6% annually on public and private lands within the monument over the 28-year period (Table 2). Approximately 25,353 (10.6%) and 43,042 (9.0%) of the forests in each buffer on public and private lands were logged over the 28-year period, corresponding to an annual rate of 0.3%-0.4% within the buffers and the monument.

Total logging over the 28-year period on private and public lands, including all buffers, resulted in approximately 43,042 acres or 1,537 acres logged annually. This is equivalent to roughly 1,435 clearcuts or 50 clearcuts annually, assuming an average clearcut size of 30 acres. Based on this analysis, annual logging rates were considered low to moderate on public lands and moderate to high on private lands using the forest change detection analysis methodologies for the Klamath-Siskiyou ecoregion provided by Staus et al. (in press). Given the coarseness of mapped based analysis and differences in sensor capabilities over the time period of this analysis, our estimates for logging levels are most probably conservative, particularly given that BLM cites 83% of the forests in the monument have been disturbed by some type of logging (USDI BLM 2002).

In general, this analysis illustrates the regional significance of the monument as an Object of Scientific Interest for terrestrial connectivity and the need for the BLM to address cumulative impacts (e.g., roads, timber harvest, development in the surroundings, positive effects of road closures in the monument) that are compromising this function. We note that habitat fragmentation is the major cause of species endangerment worldwide (see *Conservation Biology* 2001) and is especially problematic in this region (see Strittholt and DellaSala 2001, Heilman et al. 2002). Staus et al. (in press) documented a level of fragmentation from logging and road building in the Klamath-Siskiyou ecoregion of about one percent annually over the same period. This was considered a moderate rate of fragmentation (compared to the Oregon Coast Range for example) at the scale of the ecoregion but heavy in particular watersheds such as the Rogue Basin.

IV. Aquatic Connectivity as an Object of Interest

A number of aquatic species residing in streams and rivers within the monument require unimpeded access to reach spawning grounds, move to suitable rearing areas, avoid localized, unsuitable water quality conditions, and colonize or re-colonize habitats. These species include the relatively sessile aquatic snails, fish that migrate over short distances such as redband trout (*Onchorhynchus mykiss* ssp. *newberii* – BLM species of concern, US Fish and Wildlife vulnerable species), Jenny Creek sucker (*Catostomus rimiculus* – BLM special status species given presumed genetic uniqueness and rarity), and steelhead trout (*O. mykiss*), which require long-distance migrations to complete their life cycles.

Aquatic habitats can lose connectivity from any number of sources (see Trombulak and Frissell 2000 for review). Dams (either water storage or diversion) can either preclude or inhibit movement of organisms in an upstream direction and reduce survival of organisms attempting to move past these facilities in a downstream direction. Pumping stations, which draw water out of streams, can impact small, downstream migrating fishes by pulling them out of the stream along with water if they are not properly screened. Further, irrigation, other out- of- stream water use, and grazing result in contribute to both reduced stream depths, a physical barrier principally affecting upstream movement, and contribute to unsuitable water quality conditions, a behavioral barrier that may impact either upstream or downstream movement.

Improperly engineered culverts at road-stream crossings, particularly in areas with high road densities (Trombulak and Frissell 2000, PRC 2002), may result in erosion patterns that leave the downstream end of the culvert suspended above the stream channel, limiting or eliminating upstream movement of aquatic organisms. Finally, connectivity and genetic exchange among metapopulations in aquatic ecosystems is not only inhibited by physical barriers but also at the genetic level through dilution of native stocks from hybridization with exotics or introduced species. This is especially problematic given the degree of isolation of native trout in the Jenny Creek watershed (isolated by a natural water fall) and hybridization problems that are occurring with introduced rainbow trout.

V. Status and Condition of Aquatic Connectivity in the Monument

In general, the monument's aquatic integrity and connectivity have been impacted by beaver (*Castor canadensis*) trapping, livestock grazing, water diversion, and timber harvest that have significantly altered floodplains an stream channels throughout the area (see BLM DEIS 2002). Four large, permanent dams on Grizzly (1) and Keene (3) Creeks preclude upstream migration of aquatic species. Dams on Emigrant Creek and the Klamath River greatly restrict steelhead trout from reaching streams within the monument. A number of small, permanent and seasonally constructed diversion dams limit the ability of trout to migrate upstream and likely preclude other fishes. These facilities are concentrated in Jenny and Keene creeks.

In particular, the diversion near the downstream end of Keene Creek precludes passage of Klamath small-scale suckers. Young suckers migrate downstream on current from smaller streams to larger streams (Jenny Creek downstream of Keene Creek being "larger" in this instance). However, this journey takes a number of days and suckers require slow moving habitat with lots of emergent vegetation to hide during the day to avoid predation from hybridized trout. It is this stream-edge margin habitat that is largely lacking in Keene Creek. Further, we suspect that Keene Creek has disassociated from its floodplain because peak flows are rare and large wood is lacking in the floodplain. Likewise, parts of the South Fork of Keene Creek have been channelized, further restricting aquatic connectivity functions.

The diversion dams, in conjunction with numerous pumping stations that supply water for irrigation, reduce summer and fall flow levels well below the historic base flow conditions. In particular, up to one-third of the water flow in the Jenny Creek watershed is removed each year by the Talent Irrigation District, which supplies customers in the Rogue Valley. These low flows allow water temperatures, dissolved oxygen, and other water quality parameters to reach unsuitable levels that may act as a behavioral barrier to upstream and downstream fish migration.

Further, these out- of- stream uses directly reduce the depth of water flowing through shallow habitat features, physically limiting fish passage.
Livestock grazing is a common land use activity on federal lands within the monument and on the adjacent, interspersed, private lands. The effects of grazing on riparian and instream habitat conditions (reduced shading, increased stream widths/decreased stream depths, reduced channel complexity, and increased water turbidity) contribute to water quality impairment and increase the extent of shallow habitats, magnifying the effects of out- of- stream water use on the ability of aquatic organisms to migrate. The long stretches of wide, shallow, silt predominated aquatic habitat may act as an upstream dispersal barrier for aquatic species with limited movement capabilities and particular habitat demands (e.g., snails). Finally, the extent of roads and the number of road-stream crossings using culverts contribute to disconnected aquatic habitats [also see USDI BLM 1998 for related problems].

VI. Focal Species for Assessing Connectivity

Researchers have generally used focal species and/or assemblages to model and monitor connectivity (Bennett 1999). While no such species or assemblage has been identified for the monument, knowledge of habitat and dispersal requirements of focal species can be used to designate connectivity objects using a networking approach. The following are species that could function as connectivity indicators (terrestrial and aquatic) for the monument:

- northern spotted owl, northern goshawk (*Accipiter gentilis)*, Pacific fisher, and American marten for late-successional/old-growth forests;
- willow flycatcher, yellow warbler (*Dendroica petechia*), Bullock's oriole (*Icterus bullockii)*, cougar, and Pacific fisher for riparian areas;
- deer and elk for seasonal movements; Clark's nutcracker (*Nucifraga columbiana*, ridge-line movement in the fall), Townsend's solitaire (*Myadestes townsendi*, which seem to move into the area in large numbers in the fall and sometimes all winter) and merlin (*Falco columbarius,* for additional seasonal movements);
- lazuli bunting (*Passerina amoena*), Hutton's vireo (*Vireo huttoni*), warbling vireo (*V. gilvus*), brown towhee (*Pipilo fuscus)* and various butterflies (especially the Klamath mardon skipper – see butterfly section) for lowland shrublands/chaparral; green-tailed towhee (*Chlorura chlorura*) for montane chaparral;
- Jenny Creek redband trout, Jenny Creek sucker, steelhead trout, endemic aquatic mollusks for aquatic integrity; and
- acorn woodpecker (*Melanerpes formicivorus*), oak titmouse (*Baeolophus inornatus*), white-breasted nuthatch (*Sitta carolinensis*), western bluebird (*Sialia mexicana*) for oak woodlands, and lark sparrow (*Chondestes grammacus*) and western meadowlark (*Sturnella meglecta*) for grasslands.

VII. Management and Monitoring Recommendations

The importance of the monument as a land bridge offers unique opportunities for research and monitoring on its specific connectivity functions. Given the heavily disturbed landscape adjacent to the monument, it is vital that specific linkages be identified and managed in accordance with the connectivity recommendations identified herein for maintaining its crossroads integrity:

- BLM should fully recognize the unique role the monument plays as the region's only high-elevation land bridge essential to the crossroads integrity of the monument and justify its importance by declaring the connectivity function an Object of Scientific Interest.

- Document focal species and assemblages (both terrestrial and aquatic) for monitoring connectivity of the monument under a range of cover/habitat conditions.

- Monitor focal species using radio-telemetry (deer, spotted owl, merlin, redband trout) or other detection devices (e.g., smoke track plates or remote camera stations for fisher, mark and recapture for suckers) to obtain data on the extent, frequency, direction and type of movements made across particular linkages and barriers.

- Monitor status of focal species and communities in habitats connected by linkages to assess changes in response to enhanced connectivity (e.g., through specific road closures, removals of fish barriers).

- Based on monitoring, clearly define the purpose of linkages within the monument and specific management actions and goals related to mitigation of dispersal barriers.

- Match the type and dimensions of the linkages with the ecology and movement patterns of the focal species, particularly demography, home range and dispersal, and habitat requirements.

- Plan landscape linkage to facilitate movements of entire assemblages with particular attention to species having specialized requirements (e.g., endemics, range- restricted species, barrier sensitive species – fish, aquatic mollusks).

- Model cumulative impacts from logging, road building, irrigation agricultural ditches, dams, highway crossings and other barriers to fish and wildlife dispersal and develop appropriate mitigation strategies for restoring connectivity. In order to comply with NEPA provisions, provide specific forest change detection analysis and other impacts to adequately assess cumulative impacts.

- Conduct a detailed roads analysis on the impacts of roads on the monument's connectivity functions and design management plans to address these impacts.

- Close and obliterate all public lands roads not essential to right-of-way access to private lands to reduce road densities to within acceptable connectivity thresholds (note – we estimate that up to three-quarters of the public roads in the monument would need to be closed and obliterated to lower road densities from 3 - 4 mi/mi^2 to less than 1 mi/mi^2 – this would still leave 100 miles of roads for public and private access – alternatively, given the high road densities in the monument, roads could be closed and obliterated on public lands strategically to maximize road closure benefits based on a road impact analysis designed to attain maximum reduction in road densities while recognizing valid right of way access).

- Further reduce dispersal barriers through strategic road closures (e.g., Schoheim Jeep Trail) and explore the potential for highway under- or over-passes to facilitate movements in areas identified through monitoring as key dispersal corridors fractured by highways (e.g., across I-5).

- Focus restoration opportunities within Keene Creek on securing appropriate magnitude peak flows (with limits perhaps on duration) from upstream users (e.g., secure an instream flow agreement with the Bureau of Reclamation for Keene Creek) and provide instream structures (likely large wood components) to bring the stream channel back into contact with the floodplain so that the stream margin wetlands can reestablish and provide cover for migrating larval suckers. These improvements would benefit a range of aquatic and amphibious species.

- Manage habitats to minimize gaps in linkages and to recover late-seral forests from previous logging using late-seral forests with high ecological integrity (in or within the vicinity of the monument) as reference conditions.

- Restore native plant and fish communities by containing (and where possible, eliminating) exotics. Where native communities are limited in extent, use these areas as "source" areas for re-colonization and "stepping stones" for dispersal.

- Target specific areas of high ecological integrity for maintenance of connectivity and core area functions, including late-seral reserves (LSRs), Research Natural Areas (RNAs), Areas of Critical Environmental Concern (ACECs), and the Wilderness Study Area (WSA). Such areas have increased importance when they are associated with other objects (e.g., late-seral forests, riparian areas), and/or are connected along ridgelines and elevation gradients that contribute to connectivity.

- Monitor and identify streams having high water quality (based on biological, physical, and chemical indices of aquatic ecosystem integrity – see Karr and Dudley 1981, Karr 2000) and establish such areas as core refugia for aquatic species (e.g., portions of Jenny Creek, Scotch Creek, Dutch Oven Creek, particularly where they intersect the WSA and RNA).

- Manage the Horseshoe Wildlife Area and BLM Klamath canyon lands as part of the monument to facilitate connectivity (coordinate with BLM Redding and California Fish and Game through joint management MOUs).

- Analyze how future potential additions (Horseshoe Wildlife Area, Klamath canyon public lands) contribute to the viability of the monument's ecological values and Objects of Scientific Interest.

- Plan for connectivity at broad spatial scales (landscape, region) and with long time horizons. This includes working with willing sellers on land acquisitions.

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Table 1. Road density (mi/mi^2) within the Cascade-Siskiyou National Monument (CSNM – Oregon) and a 5- and 10-mile buffer surrounding the Monument on private and public lands at the scale of 1:24,000.

	Oregon			California*		
	Public	Private	Total	Public	Private	Total
CSNM	3.6	4.0	3.7	N/A	N/A	N/A
CSNM + 5 mi	3.6	3.6	3.6	3.4	3.6	3.6
CSNM + 10 mi	3.7	3.6	3.7	3.7	3.5	3.7

* only 1:100,000 roads data were available for the California portion of the study area. Thus, a scaling factor was used to arrive at road densities using similar (1:24,000) mapping scales. The scaling factor was derived by comparing the differences in road densities between 1:100,000 and 1:24,000 on the Oregon side and then applying that scaling factor to the 1:100,000 roads data on the California side (generally the increased resolution provided by 1:24,000 road density maps picked up 3-4 times as many roads as the coarser 1:100,000 scale and is similar to what has been noted by Staus et al. (in press) regarding factors of scale and increased mapping resolution.

Table 2. Changes in forest cover from 1972-2000 on public and private lands within the Cascade-Siskiyou National Monument (CSNM) and a 5- and 10-mi buffer surrounding the CSNM based on TM imagery and forest change detection methodologies in Staus et al. (in press).

		Acres (%) Logged			
	1972	1972-82	1982-92	1992-2000	Total
PUBLIC LANDS					
CSNM	45,762	-337(-0.4)	-251(-0.3)	-2,878(-3.4)	-3,466(-7.6)
CSNM+5mi	100,904	-1,380(-0.4)	-450(-0.1)	-1,835(-0.6)	-3,665(-3.6)
CSNM+10mi	223,943	-6,222(-1.0)	-340(-0.1)	-3,726(-0.6)	-10,288(-4.6)
PRIVATE LANDS					
CSNM	28,683	-3,500(-4.1)	1,762(2.1)	-5,036(-5.9)	-8,536(-29.8)
CSNM+5mi	138,345	-8,971(-2.8)	-173(-0.1)	-12,545(-4.0)	-21,689(-15.7)
CSNM+10mi	253,190	-8,668(-1.4)	-6,859(-1.1)	-17,229(-2.7)	-32,756(-12.9)
PUBLIC AND PRIVATE LANDS (TOTALS)					
CSNM	74,445	-3,837(-4.5)	1,511(1.8)	-7,913(-9.3)	-11,750(-15.8)
CSNM+5mi	239,249	-10,351(-3.3)	-622(-0.2)	-14,380(-4.5)	-25,353(-10.7)
CSNM+10mi	477,133	-14,889(-2.3)	-7,198(-1.1)	-20,955(-3.3)	-43,042(-9.0)

Figure 1: Cascade-Siskiyou National Monument Regional Elevation Data available on www.worldwildlife.org/klamathsiskiyou/NationalMonument.html

Figure 2: Cascade-Siskiyou National Monument Elevation (meters)
available on www.worldwildlife.org/klamathsiskiyou/NationalMonument.html

Figure 3: Cascade-Siskiyou National Monument 2000 Land Cover Imagery available on www.worldwildlife.org/klamathsiskiyou/NationalMonument.html

Figure 4: Cascade-Siskiyou National Monument 2000 Land Cover
available on www.worldwildlife.org/klamathsiskiyou/NationalMonument.html

Figure 5: Cascade-Siskiyou National Monument Regional Ownership Data available on www.worldwildlife.org/klamathsiskiyou/NationalMonument.html

Figure 6: Cascade-Siskiyou National Monument Jackson County Taxlots
available on www.worldwildlife.org/klamathsiskiyou/NationalMonument.html

Figure 7: Cascade-Siskiyou National Monument Roads and Forest Disturbance available on www.worldwildlife.org/klamathsiskiyou/NationalMonument.html

Figure 8: Cascade-Siskiyou National Monument Forest Change 1970s-2000
available on www.worldwildlife.org/klamathsiskiyou/NationalMonument.html

Appendix I. Presidential Proclamation.

June 9, 2000

ESTABLISHMENT OF THE CASCADE-SISKIYOU NATIONAL MONUMENT
BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A PROCLAMATION

With towering fir forests, sunlit oak groves, wildflower-strewn meadows, and steep canyons, the Cascade-Siskiyou National Monument is an ecological wonder, with biological diversity unmatched in the Cascade Range. This rich enclave of natural resources is a biological crossroads – the interface of the Cascade, Klamath, and Siskiyou ecoregions, in an area of unique geology, biology, climate, and topography. The monument is home to a spectacular variety of rare and beautiful species of plants and animals, whose survival in this region depends upon its continued ecological integrity. Plant communities present a rich mosaic of grass and shrublands, Garry and California black oak woodlands, juniper scablands, mixed conifer and white fir forests, and wet meadows. Stream bottoms support broad-leaf deciduous riparian trees and shrubs. Special plant communities include rosaceous chaparral and oak-juniper woodlands. The monument also contains many rare and endemic plants, such as Greene 's Mariposa lily, Gentner's fritillary, and Bellinger 's meadowfoam. The monument supports an exceptional range of fauna, including one of the highest diversities of butterfly species in the United States. The Jenny Creek portion of the monument is a significant center of fresh water snail diversity, and is home to three endemic fish species, including a long-isolated stock of redband trout. The monument contains important populations of small mammals, reptile and amphibian species, and ungulates, including important winter habitat for deer. It also contains old-growth habitat crucial to the threatened Northern spotted owl and numerous other bird species such as the western bluebird, the western meadowlark, the pileated woodpecker, the flammulated owl, and the pygmy nuthatch.

The monument 's geology contributes substantially to its spectacular biological diversity. The majority of the monument is within the Cascade Mountain Range. The western edge of the monument lies within the older Klamath Mountain geologic province. The dynamic plate tectonics of the area, and the mixing of igneous, metamorphic, and sedimentary geological formations, have resulted in diverse lithologies and soils. Along with periods of geological isolation and a range of environmental conditions, the complex geologic history of the area has been instrumental in producing the diverse vegetative and biological richness seen today.

One of the most striking features of the Western Cascades in this area is Pilot Rock, located near the southern boundary of the monument. The rock is a volcanic plug, a remnant of a feeder vent left after a volcano eroded away, leaving an outstanding example of the inside of a volcano. Pilot Rock has sheer, vertical basalt faces up to 400 feet above the talus slope at its base, with classic columnar jointing created by the cooling of its andesite composition.

The Siskiyou Pass in the southwest comer of the monument contains portions of the Oregon/California Trail, the region 's main north/south travel route first established by Native Americans in prehistoric times, and used by Peter Skeene Ogden in his 1827 exploration for the Hudson 's Bay Company.

Section 2 of the Act of June 8,1906 (34 Stat.225,16 U.S.C.43 1),authorizes the President, in his discretion, to declare by public proclamation historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest that are situated upon the lands owned or controlled by the Government of the United States to be national monuments, and to reserve as a part thereof parcels of land, the limits of which in all cases shall be confined to the smallest area compatible with the proper care and management of the objects to be protected.

WHEREAS it appears that it would be in the public interest to reserve such lands as a national monument to be known as the Cascade-Siskiyou National Monument:

NOW, THEREFORE, I, WILLIAM J. CLINTON, President of the United States of America, by the authority vested in me by section 2 of the Act of June 8, 1906 (34 Stat. 225, 16 U.S.C. 43 1), do proclaim that there are hereby set apart and reserved as the Cascade-Siskiyou National Monument, for the purpose of protecting the objects identified above, all lands and interests in lands owned or controlled by the United States within the boundaries of the area described on the map entitled "Cascade-Siskiyou National Monument " attached to and forming a part of this proclamation. The federal land and interests in land reserved consist of approximately 52,000 acres, which is the smallest area compatible with the proper care and management of the objects to be protected.

All federal lands and interests in lands within the boundaries of this monument are hereby appropriated and withdrawn from all forms of entry, location, selection, sale, or leasing or other disposition under the public land laws, including but not limited to withdrawal from location, entry, and patent under the mining laws, and from disposition under all laws relating to mineral and geothermal leasing, other than by exchange that furthers the protective purposes of the monument. There is hereby reserved, as of the date of this proclamation and subject to valid existing rights, a quantity of water sufficient to fulfill the purposes for which this monument is established. Nothing in this reservation shall be construed as a relinquishment or reduction of any water use or rights reserved or appropriated by the United States on or before the date of this proclamation.

The commercial harvest of timber or other vegetative material is prohibited, except when part of an authorized science-based ecological restoration project aimed at meeting protection and old growth enhancement objectives. Any such project must be consistent with the purposes of this proclamation. No portion of the monument shall be considered to be suited for timber production, and no part of the monument shall be used in a calculation or provision of a sustained yield of timber. Removal of trees from within the monument area may take place only if clearly needed for ecological restoration and maintenance or public safety.

For the purpose of protecting the objects identified above, the Secretary of the Interior shall prohibit all motorized and mechanized vehicle use off road and shall close the Schoheim Road, except for emergency or authorized administrative purposes. Lands and interests in lands within the monument not owned by the United States shall be reserved as a part of the monument upon acquisition of title thereto by the United States.

The Secretary of the Interior shall manage the monument through the Bureau of Land Management, pursuant to applicable legal authorities (including, where applicable, the Act of August 28, 1937, as amended (43 U.S.C.11 8 la-I 18 lj)),to implement the purposes of this proclamation.

The Secretary of the Interior shall prepare, within three years of this date, a management plan for this monument, and shall promulgate such regulations for its management as he deems appropriate. The management plan shall include appropriate transportation planning that addresses the actions, including road closures or travel restrictions, necessary to protect the objects identified in this proclamation. The Secretary of the Interior shall study the impacts of livestock grazing on the objects of biological interest in the monument with specific attention to sustaining the natural ecosystem dynamics. Existing authorized permits or leases may continue with appropriate terms and conditions under existing laws and regulations. Should grazing be found incompatible with protecting the objects of biological interest, the Secretary shall retire the grazing allotments pursuant to the processes of applicable law. Should grazing permits or leases be relinquished by existing holders, the Secretary shall not reallocate the forage available under such permits or for livestock grazing purposes unless the Secretary specifically finds, pending the outcome of the study, that such reallocation will advance the purposes of the proclamation.

The establishment of this monument is subject to valid existing rights.

Nothing in this proclamation shall be deemed to enlarge or diminish the jurisdiction of the State of Oregon with respect to fish and wildlife management.

Nothing in this proclamation shall be deemed to revoke any existing withdrawal, reservation, or appropriation; however, the national monument shall be the dominant reservation.

Warning is hereby given to all unauthorized persons not to appropriate, injure, destroy, or remove any feature of this monument and not to locate or settle upon any of the lands thereof.

IN WITNESS WHEREOF, I have hereunto set my hand this ninth day of June, in the year of our Lord two thousand, and of the Independence of the United States of America the two hundred and twenty-fourth.

WILLIAM J.CLINTON

Appendix II. Contributor Biographies

Richard Brock, M.S. (*Vegetation Patterns, Rare Plants and Plant Associations*) is a professional field botanist with 18 years experience studying the plant communities of southwest Oregon. He has conducted intensive surveys and plant community mapping on nearly 5,000 acres of the Cascade-Siskiyou National Monument since 1988.

Dominick DellaSala, Ph.D. (*Mixed Conifer Forests, Landscape and Habitat Connectivity*) is Director of World Wildlife Fund's Klamath-Siskiyou Regional Program in Ashland, Oregon. His expertise includes forest and landscape ecology and conservation biology, forest ecosystem restoration, forest fire management, and endangered species management. Dr. DellaSala is an internationally renowned author of over 100 technical papers, is co-author of two books on biodiversity and sustainable forest management, and subject editor for the Natural Areas Journal. He has been involved in numerous national and regional protected areas campaigns spanning two decades of conservation and including the establishment of national monuments, roadless area protections, and land acquisitions in the Pacific Northwest, Alaska and Canada.

Evan Frost, M.S. (*Compiler, Fire as an Object of Scientific Interest*) received a Bachelor of Arts in Biology from Kalamazoo College (1985) and a Master of Science in Biology from Humboldt State University (1992). Since 1999, he has worked as a Terrestrial Ecologist with Wildwood Environmental Consulting, on a wide range of ecological and botanical projects. He also serves as Managing Editor for *Mountains & Rivers: A Journal of Natural History for the Klamath-Siskiyou Region*, published by the Siskiyou Field Institute.

Prior to establishing himself as a consultant in southwest Oregon, Evan served as a botanist and ecologist for a several organizations in the Pacific Northwest, including the Northwest Ecosystem Alliance, Pacific Biodiversity Institute (WA) and the U.S. Forest Service (CA). Evan's research interests focus on fire ecology in the Klamath-Siskiyou region, conservation biology and rare plant conservation and monitoring. He has authored several publications in peer-reviewed scientific journals and numerous technical reports and papers on these topics.

Dennis Odion, Ph.D. (*Compiler, Chaparral and Other Shrub-dominated Vegetation, Fire as an Object of Scientific Interest*) received his Masters Degree in Botany (1984) and Ph.D. in Geography (1995) from UC-Santa Barbara. He has been involved in research on fire ecology of plants for twenty years and published several papers on this topic. His work has focused on how species whose reproduction depends on fire are maintained in chaparral vegetation, where fire adaptation is most common. He has also studied and published a number of papers and reports on wetlands, riparian forests, desert vegetation, native grasslands and oak woodlands.

Dr. Odion also has extensive experience in the conservation of rare plants, communities, and problems of invasive species and has written several papers and reports, most notably, based on research funded by the Nature Conservancy and California Department of Fish and Game. From 1995 to 2000, he also worked as the vegetation ecologist for the Marin Municipal Water District, managing a 20,000-acre watershed where chief issues involved how to manage fire in wildlands adjacent to a large urban area, exotic species invasions, and maintaining a number of endangered plants.

Joel E. Pagel, M.S. (*Peregrine Falcons***)** is the Principal Investigator of the Pacific Northwest Interagency peregrine falcon project, a position he has held since 1983. He has been collecting ecological data and coordinating monitoring efforts on peregrine falcons in the Pacific Northwest (including southern Oregon) for the past twenty years. Concurrent with this position, he is also Research Associate with the Santa Cruz Predatory Bird Research Group (since 1984), and a Ph.D. Candidate in the Ecology Graduate Group at the University of California-Davis (since 1998).

Michael Parker, Ph.D. (*Aquatic Environments and Associated Fauna*) has a Bachelor of Science in Biology from Southern Oregon University (1981), a Masters of Science in Biology (with an emphasis in Aquatic Ecology) from University of Nevada, Las Vegas (1984), and a Ph.D. in Ecology (emphases in Limnology and Community Ecology) from the University of California, Davis (1992). He has been on the biology faculty at SOU since 1994 and has taught courses in aquatic ecology, fisheries biology, vertebrate natural history and natural history of Oregon, and environmental ethics, among others. Before coming to SOU he was a research associate at the University of California, Berkeley (Department of Integrative Biology) for two years and taught freshwater ecology in the forestry department there.

His research focuses on streams and rivers primarily, with a special emphasis on (1) understanding ecological consequences of human disturbance and (2) conservation of aquatic biodiversity. Some recent projects include unraveling the effects of dams/flow regulation on energy pathways through stream food webs (i.e., why juvenile salmonids may be starving in regulated rivers), and evaluating alternatives to herbicides for control of nuisance aquatic vegetation in irrigation canals with connections to salmon-bearing streams. He also has an on-going, long-term project in the Ash Meadows National Wildlife Refuge in southern Nevada, in which he and colleagues are attempting to restore desert spring habitats inhabited by federally listed fish (pupfish and dace) and invertebrates. Dr. Parker has numerous publications in peer-reviewed scientific journals, a couple of book chapters on river food webs, and numerous technical reports.

Erik Runquist (*Butterflies and Moths*) is southern Oregon's Lepidopteran expert. He has been studying butterfly and moth diversity within the area of the CSNM for the last 12 years – including a 1999 contract under the Medford BLM – and is currently examining the population biology of the Mardon Skipper. Currently, he is graduate student in the Ecology Department at University of California, Davis.

Pepper W. Trail, Ph.D. (*Birds of the Cascade-Siskiyou National Monument*) is Conservation Chair for Rogue Valley Audubon Society. He is a professional ornithologist with a Ph.D. in ecology and animal behavior from Cornell University. He a member of the American Ornithologists Union and the Society for Conservation Biology, and has published many scientific papers on the behavior, ecology, and conservation of birds. Dr. Trail serves as a member of the Jackson County Bird Checklist Committee, and has recently authored several species accounts for the volume "*Birds of Oregon: A General Reference*" to be published by OSU Press in 2003. He frequently conducts bird surveys and leads field trips in the Cascade-Siskiyou National Monument, and has worked for the area's protection since 1995.