

Conservation Assessment for the
Siskiyou Mountains Salamander
(*Plethodon stormi*)

Version 1.4

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**U.S.D.A. Forest Service Region 6 and
U.S.D.I. Bureau of Land Management, Oregon and Washington**

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Disclaimer

This Conservation Assessment was prepared to compile the published and unpublished information on the Siskiyou Mountains salamander (Plethodon stormi). Although the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise and be included. If you have information that will assist in conserving this species or questions concerning this Conservation Assessment, please contact the interagency Conservation Planning Coordinator for Region 6 Forest Service, BLM OR/WA in Portland Oregon.

Executive Summary

Species: Siskiyou Mountains salamander (*Plethodon stormi*).

Taxonomic Group: Amphibian

Management Status: U.S.D.A. Forest Service, Region 6 - Sensitive, Region 5 - Sensitive; U.S.D.I. Bureau of Land Management, Oregon - Sensitive, California - no status; California State Threatened species; Oregon State Sensitive-Vulnerable species; U.S. Fish and Wildlife Service Species of Concern; The Natural Heritage Program ranks this species as Globally imperiled (G2G3Q), California State Critically imperiled or imperiled (S1S2), Oregon State imperiled (S2, and ORNHIC List 1). Management of the species follows Forest Service 2670 Manual policy and BLM 6840 Manual direction. (Additional information, including species specific maps, is available on the Interagency Special Status and Sensitive Species website, www.or.blm.gov/issp).

Range: The Siskiyou Mountains salamander is only found in an approximately 150,000 ha area of northwestern California and southwestern Oregon. It occurs primarily in northern Siskiyou County, California, southern Jackson County, Oregon, and extreme southeast Josephine County, Oregon. It has been found from 488 to 1830 m (1488-6000 ft) elevation; recent surveys have found new locations and extended the range.

Specific Habitat: Siskiyou Mountains salamanders are typically found in forested habitats with deep rocky soils or talus and rocky outcrops. They also can be found under bark, logs, or other debris but always in association with rocky soils. Individuals are most often found by searching under rocks on the forest floor during wet weather. In the dry summer season they retreat into the soil. Using habitat associations research, a map of high potential habitat has been developed for this species in the northern portion of its range (Figure 2).

Threats: Habitat loss, degradation, and additional fragmentation of discrete populations are all potential threats to this species. Activities that may pose threats to this species are those that disturb the surface microhabitats and/or microclimate conditions. Typically these involve actions that remove canopy and/or disturb the substrate. Removal of canopy overstory may cause desiccation of the rocky substrates and loss of the moss ground cover, a microhabitat feature of Siskiyou Mountain salamander sites. Disturbing the substrate can result in substrate compaction and deconsolidation of the stabilized talus, which reduces or eliminates substrate interstices used by salamanders as refuges and for their movements up and down through the substrate. Examples of the types of activities that may cause impacts include: certain types of timber harvest and associated road construction, rock quarry management and construction, and prescribed as well as wildland fire. As the majority of known sites occur on Federal lands, Federal land management activities may create the highest potential threat to the species.

Management Considerations: Considerations for maintaining local populations include maintaining undisturbed cool, moist surface and subsurface refuges. Timing of activities to outside of the season when animals are surface active is a consideration for this species' management. Some habitat disturbing activities that could harm the species at those times when

the animals are surface active (i.e., winter/spring) may be relatively benign at other times when the animals are not surface active (e.g., fall prescribed fire). Activities in areas adjacent to sites may impact microclimate directly or by altering the risk of disturbance.

The geographic distribution of both sites and distinct populations are considerations for management. Occupancy rates of suitable habitat varies geographically with higher occupancy rates in Oregon and California north of the Siskiyou Mountains crest, and lower rates in the Klamath River Valley in California.

Inventory, Monitoring and Research Opportunities: There are many data gaps for this species that can be answered by using various techniques of inventory, monitoring and research. Some of the vital questions are what are the microhabitat and environmental requirements for this species and what are the potential effects of various types of land management activities. Basic inventory techniques may assist in locating new populations or to monitor known sites over the long term to determine population trends. Research is needed on the genetic relationships between populations, in particular, on recent gene flow between populations, microclimate requirements, and the effects of land management activities on this species.

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I. Introduction

Goal

The primary goal of this conservation assessment is to provide the most up to date information known about this species including life history, habitat, and potential threats, and to describe habitat and site conditions that may be desirable to maintain if management of a particular site or locality for the species is proposed. This species is a rare endemic vertebrate with a known range restricted to a small portion of the Siskiyou Mountains in southern Oregon and northern California. It is recognized as a potentially vulnerable species by various federal and State agencies because it is potentially vulnerable to land management activities and natural disturbances (wildland fire) that occur within its range. Although this conservation assessment does include biological information regarding this species in California, the goals and management considerations of this assessment are specific to BLM and Forest Service lands in Oregon. The information presented here is compiled to help manage the species in accordance with Forest Service Region 6 Sensitive Species (SS) policy and Oregon/Washington Bureau of Land Management Special Status Species (SSS) policy, and as a useful tool to use to maintain well-distributed populations consistent with direction from the National Forest Management Act. Additional information for Region 6 SS and Oregon BLM SSS, including species specific maps, is available on the Interagency Special Status Species website.

For Oregon/Washington Bureau of Land Management (OR/WA BLM) administered lands, SSS policy (6840 manual and IM OR-91-57) details the need to manage for species conservation.

For Region 6 of the Forest Service, SS policy requires the agency to maintain viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands. Management “must not result in a loss of species viability or create significant trends toward federal listing” (FSM 2670.32) for any identified SS.

Scope

The range of the Siskiyou Mountains salamander includes Jackson and Josephine Counties in Oregon, and Siskiyou County in California. This assessment addresses federal land management and conservation goals on BLM and FS lands in Oregon only: the Rogue River-Siskiyou National Forest and the Medford District of the Bureau of Land Management.

Management Status

State and federal agencies consider the Siskiyou Mountains salamander as a vulnerable species due to its rarity and vulnerability to a variety of anthropogenic disturbances. It is listed by the U.S.D.A. Forest Service, Regions 5 and 6 as Sensitive, and by the U.S.D.I. Bureau of Land Management, Oregon as Sensitive. This species is not known on BLM lands in California. In addition the species is listed by California State as Threatened; Oregon State as Sensitive-Vulnerable species; and by the U.S. Fish and Wildlife Service as a Species of Concern. The Natural Heritage Program ranks this species as ORNHIC List 1, Globally imperiled (G2G3Q), California State Critically imperiled or imperiled (S1S2), Oregon State imperiled (S2). Management of the species on Forest Service Region 6 and Oregon BLM lands follows Forest Service 2670 Manual policy and BLM 6840 Manual direction.

II. Classification and Description

Systematics

The Siskiyou Mountains salamander (*Plethodon stormi*) is a member of the family Plethodontidae, the lungless salamanders and the genus *Plethodon*, the Woodland Salamanders. These animals respire entirely through their skin, complete their entire life cycle in terrestrial environments and are found on the forest floor in moist microhabitats. Like other *Plethodon* they are slim and elongate with relatively short legs. The Siskiyou Mountains salamander along with the Del Norte salamander (*P. elongatus*) composes the *elongatus* group of western *Plethodon* (Brodie 1970).

The Siskiyou Mountains salamander is morphologically and genetically distinct from both the Del Norte salamander and the recently discovered Scott Bar salamander (*Plethodon asupak*) (Mahoney 2004, Mead et al 2005, DeGross 2004). Together the Siskiyou Mountains and Del Norte salamanders seem to be descended from a single common ancestral form that is a sister taxa to the basal Scott Bar Salamander (Mahoney 2004, Mead et al. 2005). Because its status was uncertain until recently, localities of the Scott Bar salamander have been treated as Siskiyou Mountains salamanders by land management and regulatory agencies.

The Siskiyou Mountains salamander appears to be most closely related to the Del Norte salamander (Brodie 1970, Mahoney 2004). The 2 species are in close proximity along the western edge of the Siskiyou Mountain salamanders range. The Siskiyou Mountains salamander is composed of two parapatrically distributed monophyletic mtDNA groups (Pfrender and Titus 2001, Mahoney 2004). Recent work with nuclear markers indicates that some limited gene flow may have recently occurred or may be ongoing along the contact between the 2 mtDNA clades in California but not in Oregon (DeGross 2004). Because the 2 mtDNA groups of the Siskiyou Mountains salamander meet the criteria outlined by Moritz (1994; reciprocally monophyletic mtDNA haplotypes and significant differences in allele frequencies at nuclear genes) DeGross (2004) suggested that they be managed as separate

Evolutionarily Significant Units [ESU]. One ESU occupies the majority of the range of the Siskiyou Mountains salamander while the other is limited to a small area north and south of the Klamath River immediately east of Happy Camp, California.

Species Description

The Siskiyou Mountains salamander is similar in appearance to the Del Norte salamander (*P. elongatus*). Recent surveys have uncovered populations of both Siskiyou Mountains salamanders and Del Norte salamanders within one mile of each other north and south of the Klamath River near Happy Camp, California (Mahoney 2004). There is also evidence of sympatry of the two species at two sites near Happy Camp and Grider Creek (Louise Mead pers comm. 2005)

Siskiyou Mountains salamanders are slim and long-bodied (approximately 14-70 mm snout-vent length), and are chocolate-brown to purplish-brown, dorsally, with varying amounts of light flecking on the head, sides, and limbs. Adults may have a faint lighter brown dorsal stripe, and the ventral color is grayish-purple. Juveniles tend to be black or very dark brown with flecking, often exhibit a light brown or tan dorsal stripe, and are gray ventrally. An adult *P. stormi* is distinguished from this close relative by having a modal number of 17 costal grooves and 4 to 5.5 intercostal folds between adpressed limbs, while the Del Norte has 18 and 5.5-7.5, respectively (Jones et al. 2004, Leonard et al. 1993, Nussbaum et al. 1983). Moreover, the Del Norte Salamander may have a reddish dorsal stripe and juvenile Del Norte salamanders differ from juvenile Siskiyou Mountains salamanders in that juvenile Del Norte salamanders usually possess a bright, coppery dorsal stripe that can fade with age. However, within the contact zone of these two species and *P. asupak* (Mead et al. 2004), morphological characters such as dorsal stripe and intercostal folds potentially may not be characteristics that will identify species readily.

III. Biology and Ecology

Life History

Siskiyou Mountains salamanders are active on the ground surface, primarily at night when it is cool and moist. Peak active periods occur during the wet season, with periods of inactivity during freezing temperatures. They may forage at the surface during the dry summer (Nussbaum et al. 1983). They adopt a sit-and-wait foraging behavior, and prey on a variety of small terrestrial invertebrates, including spiders, pseudoscorpions, mites, ants, collembolans, and beetles (Nussbaum et al. 1983). Ants may be an important dietary component in the spring, while millipedes appear to be eaten by larger adults in the fall (Nussbaum 1974). Predators are largely unknown but may include sympatric snake and shrew species. Potential competitors may include ensatina and black salamanders which also occur in similar habitat. Nothing is known of parasites and disease or symbiotic and mutualistic interactions with other species.

Movements

Siskiyou Mountains salamanders are thought to have limited dispersal ability. They make daily to seasonal vertical migrations in the ground surface as microclimate conditions change, but not extensive horizontal movements. Genetic analyses indicate limited gene flow and suggest that populations may have been on isolated evolutionary pathways for a very long time.

Breeding biology

These salamanders are entirely terrestrial; they do not require standing or flowing water at any stage of their life cycle. Eggs are thought to be laid in nests below the ground, deep in rocky substrate. Courtship probably occurs during the spring rainy season on the talus surface (Nussbaum et al. 1983). In the early spring, females retreat down into the talus and establish nests. Dissected females (sample of 37) had clutches of 2-18 eggs, with an average of 9 eggs per clutch (Nussbaum et al. 1983). The eggs are laid in a grape-like cluster and are tended by the female until hatching in the fall. Juveniles emerge in late fall and early spring. Welsh and Lind (1992) reported that juveniles captured in mid-spring were significantly larger than would be expected if newly hatched. They mature at 5-6 years, and appear to be relatively long-lived (up to 15 years). Females appear to breed every other year.

Range, Distribution, and Abundance

The Siskiyou Mountains salamander occurs in an approximately 150,000 ha area in southwestern Oregon and northwestern California (Nauman and Olson 1999, Figure 1). It has been found in southern Jackson County, the extreme southeast portion of Josephine County, Oregon, and northern Siskiyou County, California. It is known from sites ranging from 488 m (1488 ft.) (Nussbaum et al. 1983) to about 1800 m (6000 ft) (Clayton et al. 1999) in elevation. To date, there are over 200 localities known for the species (Nauman and Olson 1999, Reilly pers comm.). The knowledge of this species' distribution has grown considerably in the last 20 years; a prior reference distribution of this species is unknown.

The Siskiyou Mountains salamander occurs primarily on federal lands within the Klamath/Siskiyou Mountains. It is found within all federal land allocations (Adaptive Management Areas (AMA), Administratively Withdrawn areas, Congressionally Reserved areas, Late Successional Reserves, and Matrix lands). This species has been documented to occur on the Medford Bureau of Land Management, Ashland and Grants Pass Resource Areas, the Applegate Ranger District of the Rogue and Siskiyou National Forest and the Happy Camp and Scott River Ranger Districts of the Klamath National Forest. The majority of the known and suspected range of the species is on federal lands and most known sites occur on two federal land allocations: Adaptive Management Areas (67%) and Late-Successional Reserves (27%) (Nauman and Olson 1999). Seven percent (7%), of sites occur on non-federal lands. Distributions of sites within the Applegate portion of the range are primarily on AMA lands

(67%), some reserves (18%), and private lands (16%) (Nauman and Olson 1999). In the southwest portion of the range, site distribution is primarily on reserve lands (67%), with 31% of sites on Matrix land.

Within the suspected range of *P. asupak*, most occurrences are on Matrix or private lands (60%) with the remaining sites occurring on reserved lands (40%) (Nauman and Olson 1999). Genetic work has not been conducted on these occurrences to determine if they are *P. asupak* or not. The California Department of Fish and Game reported approximately 45 localities from within the suspected range of *P. asupak*, but these have not been confirmed by genetic analysis, and may actually represent fewer distinct occurrences (California Dept. of Fish and Game, 2004).

An inventory of all known Siskiyou Mountains salamander sites on the Applegate Ranger District in 1992 yielded abundances of salamanders ranging from 0.3 to 11 captures per person-hour (D. Clayton, unpubl. data, 1993). A habitat associations study from 1994 to 1997 yielded densities of salamanders ranging from 1 to 16 animals per 49 square meter search plot (i.e., 0.02-0.33 animals/m², Ollivier et al. 2001). Nauman and Olson (2004) reported an average of 0.01 salamanders/m² and 2.39 salamanders/person-hour in California, with lower elevations having higher capture rates. In comparison, other plethodontid capture rates in the western United States can be much higher (Nussbaum et al. 1984)

Population Trends

Little is known about population trends in this species.

Habitat

Siskiyou Mountains salamanders are exclusively found in association with rocky substrates (Nussbaum et al. 1983). These substrates may range from gravelly soils to talus but there is always some component of rock. Although exceptions exist, most known sites consist of forested areas. Individuals are found by searching under rocks, bark, logs or other debris on the forest floor during wet weather (Petranka 1998).

Factors that create a cool, moist microclimate strongly influence the distribution and abundance of the Siskiyou Mountains salamander. Shading provided by vegetation, aspect and topography appears to play a significant role in creating the conditions associated with *Plethodon* salamanders. Forested stands with high canopy closure and larger conifers, when associated with rocky soils, often harbor abundant populations of Siskiyou Mountains salamander (Nussbaum et al. 1983, Ollivier et al. 2001, H. Welsh unpublished data, N. Suzuki unpublished data). These stands are most common on north facing slopes where this species reaches its highest abundances (Nussbaum et al. 1983) and is most commonly encountered (Farber et al. 2001). However, populations are known from all seral stages and aspects (Farber et al. 2001; Ollivier et al. 2001). In younger stands and more southerly aspects micro-site topography may provide shading allowing salamanders to exist in areas that otherwise would be inhospitable.

E. Reilly, H. Welsh, and N. Suzuki are conducting research that utilizes an index of topographic shading. Digital elevation data and a geographic information system are used to create an "Illumination Index". Preliminary results suggests that salamander populations are associated with areas that are shaded by topography (E. Reilly, H. Welsh and N. Suzuki unpublished data). This approach offers great promise in untangling the complex interaction of vegetation, aspect and topography that appear to interact to create suitable conditions for Siskiyou Mountains salamanders.

Precipitation has been associated with the presence and abundance of Siskiyou Mountain salamanders (Ollivier et al 2001, H. Welsh unpublished data). Dry conditions likely limit the species eastward extent. In one study conducted in California, Siskiyou Mountains salamanders were encountered at a greater proportion of sample points and in greater abundances in the wet western side of the range when compared to the much drier eastern side of the range (Nauman and Olson 2004). Siskiyou Mountains salamanders need a moist, relatively cool habitat. Precipitation, canopy cover, aspect, and topographic shading directly affect salamanders by creating the conditions necessary for persistence. The abundance of moss and ferns, the number of hardwood trees and years since disturbance (Ollivier et al. 2001) are associated with salamanders because they reflect the stable existence of cool, moist conditions over longer periods of time.

Ecological Considerations

Plethodontid salamanders are thought to have important roles in forest ecosystems, including being a significant trophic link between small ground-dwelling invertebrates and larger vertebrate predators. They also comprise a considerable portion of the forest vertebrate biomass in some areas (e.g., Burton and Likens 1975a, 1975b), but the specific role of *P. stormi* in local communities or ecosystem processes has not been addressed. Welsh and Droege (2001) suggest that because of their general ecology and life history they are ideal indicators of forest ecosystem integrity.

IV. Conservation

Threats

Optimal habitat for these animals includes late seral forest conditions with rocky substrates and cool, moist microclimates. Activities that may pose threats to this species are those that disturb the surface microhabitats and/or microclimate conditions. Disturbance of surface microhabitats is of primary concern because alteration of the microhabitat and microclimatic conditions can negatively impact these salamanders. Typically these involve actions that remove canopy and/or disturb the substrate.

Examples of threats include timber harvest, road construction, rockpit mining, and development of large recreation sites. Wildland fire is also a primary threat to this species. Other activities, such as prescribed fire, trail construction, and chemical applications may pose somewhat lesser

or localized threats to the species and do not likely pose a threat to species persistence. All these are presumed threats to this salamander, as no studies have been published to document losses from specific anthropogenic disturbances in this species. These activities and their impacts to these salamanders are discussed below.

Timber Harvest

Several disturbances can result from timber harvest practices. Removal of overstory may cause desiccation of the rocky substrates and loss of the moss ground cover, a microhabitat feature of Siskiyou Mountain salamander sites. Tree-felling and ground-based logging systems disturb the substrate which can result in substrate compaction and deconsolidation of the stabilized talus, which reduces or eliminates substrate interstices used by salamanders as refuges and for their movements up and down through the substrate. Site preparation practices such as broadcast burning removes the moss covering that helps to stabilize the talus.

Within the range of the Siskiyou Mountains salamander, the landscape is somewhat fragmented by past timber harvest practices and current fire regimes, and is a patchwork of stands of different seral stages, from early seral to mature forests. Siskiyou Mountains salamanders and their habitat are found nested within this patchy forested regime. There are no real estimates of how much potential suitable habitat has been impacted by timber harvest activities, but using soil mapping as a basis for projecting potential habitat, 10% of the total potential habitat (10,000 acres, 4,047 ha) on the Applegate Ranger District, Rogue River National Forest, had been harvested between 1984 and 1994 (D. Clayton, unpubl. data).

Although no studies have been completed specifically for this species, many studies have reported effects to plethodontid salamanders from timber harvest, in particular regeneration or clearcut harvest practices (Ash 1997, Dupuis et al. 1995, deMaynadier and Hunter 1995, Herbeck and Larsen 1999, Grialou et al. 2000). DeMaynadier and Hunter (1995) reviewed 18 studies of salamander abundance after timber harvest and found median abundance of amphibians was 3.5 times greater on controls over clearcuts. Petranka et al (1993) found that *Plethodon* abundance and richness in mature forest were five times higher than those in recent clearcuts and they estimated that it would take as much as 50-70 years for clearcut populations to return to pre-clearcut levels. A comparison of recent (<5 years) clearcuts and mature (120 years) forests also suggested salamanders are eliminated or reduced to very low numbers when mature forests are clearcut (Petranka et al. 1994). In a paired plot study, H. Welsh et al. (unpubl. data) found that *P. elongatus* salamanders were greatly reduced for as long as twelve years after clear cutting when compared with an adjacent control plot. They also found significantly higher number of juveniles in the clearcut compared to the control and concluded that the clearcut was likely acting as a “sink” habitat for the juveniles. In contrast, Messere and Ducey (1998) found no significant differences in abundance of red-backed salamanders in forest canopy gaps in stands that had been selectively logged, indicating that limited logging may have little effect on that species.

Studies in the Pacific Northwest documented greater salamander abundance in old-growth compared to clearcuts or early seral forest (e.g. Bury and Corn 1988, Raphael 1988, Welsh and

Lind 1988 and 1991, Welsh 1990, Corn and Bury 1991, Dupuis et al. 1995, Ollivier et al. 2001). Alternatively, Diller and Wallace (1994) found *P. elongatus* in managed young stands in northwestern California and found no relationship of salamander presence to forest age. However, they sampled stands that were from zero to 90 years old. The areas surveyed were also in the coastal redwoods that have a milder, wetter climate than interior sites sampled by others (Ollivier et al. 2001, Welsh and Lind 1991) and are similar to areas where the Siskiyou Mountains salamander is found.

Although no published studies address the direct affects of timber harvest activities on the Siskiyou Mountains salamander as has been done in other similar species (Petranka et al 1993, Dupuis et al. 1995, deMaynadier and Hunter 1995, Ash 1997, Herbeck and Larsen 1999), surveys in timber sale units after harvest have shown marked reductions in capture rates. A site adjacent to the type locality was surveyed in 1993 immediately after a clearcut harvest and broadcast burn (D. Clayton, unpubl. data), and a high number of individuals (10+captures/person-hour) were found. Subsequent surveys showed a rapid loss of individuals detected at the site, and since 1995, no salamanders were found at the site until 1999 when one was found (California Department of Fish & Game 2004). In 2003, two searches conducted by the California Department of Fish and Game yielded 3 salamanders in 17 minutes and 5 salamanders in 75 minutes (California Department of Fish & Game 2004). This data is inconclusive but it may indicate some recolonization of the site or a sink habitat where individuals are dispersing from a nearby source habitat and may not survive.

Since all of these studies have been conducted, federal timber management practices have changed significantly. Clear-cut logging is no longer carried out on Forest Service or BLM lands within the range of this species, as regeneration harvests now maintain large down logs, large snags, and 15% of the original stand as green retention trees. Substrate impacts may still occur but agency standards limit this to 20% of the harvest unit. Given the wide range of study results on a variety of Plethodon species, it is difficult to know at what level canopy reduction is significant enough to render an area unsuitable. However, based on scatter plot data from the Ollivier et al. work (2001), salamander capture rates declined significantly when canopy closures were below approximately 70 percent.

Roads

Many roads have been constructed for easy access to existing rock sources to use as road-surfacing material. Road construction in suitable habitat directly removes overstory and compacts the substrate. The intensity of impacts are more intense and longer lasting than timber harvest. Road construction likely causes direct mortality to individuals and some amount of habitat loss; however due to the scale of impact and the linear nature of the action, the impacts to the species may be significantly less than timber harvest or stand replacement fire. Roads are not generally known to be barriers to plethodontid salamanders, and *P. stormi* has been found in road cuts. Road kill is not well-documented for this species.

Rockpit Mining

Rock sources are mined for a variety of uses. These operations remove large amounts of material far back into a hillside or mountain. Overstory and substrate may be removed. Such operations undoubtedly remove both surface and subsurface refugia permanently, and likely have impacted local populations. However, due to the scale of this action across the range of this species, this action is not considered to be a primary threat.

Developed Recreation/Dispersed Camping

Construction of camping areas, access roads, boat ramps, and other developed recreation sites have likely impacted Siskiyou Mountains salamanders, particularly around Applegate Lake, by the direct alteration of substrate as well as canopy loss due to overstory vegetation removal. Dispersed campsites also may have had an impact from soil compaction and vegetation alteration, although it is expected to be somewhat limited.

Chemical Applications

Herbicides, pesticides, fire retardants, and fertilizers may have a direct impact on Siskiyou Mountains salamanders. These animals breathe through their skin, which must be moist and permeable for gas exchange. It is not known to what extent these substances may have affected Siskiyou Mountains salamander populations in the past. However, this type of activity only occurs on a very limited basis on FS and BLM lands and then usually only at disturbed sites with invasive species concerns. It is not likely a high concern for this species.

Fire

Impacts to Siskiyou Mountains salamanders from either natural or prescribed fire are unstudied, however, given that fire suppression in recent years has resulted in an increased risk of large stand replacement fire in the region, large fires that remove overstory from suitable habitat may be of highest concern for this species (an example of this is the Biscuit Fire). Although the Siskiyou Mountains salamander has persisted in a fire disturbance landscape, there is concern that the intensity of the local fire regime has changed and when burned may have adverse effects on the species. The relatively recent historical fire regime in the area was one of high frequency and low intensity fire, which consisted of very frequent underburning of the forest in the summer and early fall and few stand replacement events, at least at the lower elevations (Agee 1993). At higher elevations, longer fire return interval and high intensity fire occurred historically and likely resulted in more stand replacement events (Agee 1993). The effects of a more intense level of fire disturbance due to fire suppression and fuel loading is of concern in that stand replacement fire represents a higher potential for disturbance to flora and fauna. In particular, relative to salamander habitat, it removes overstory canopy that serves to moderate surface microclimates from extremes (e.g., high temperatures and low moisture).

Recent federal management strategies emphasize fuel prescriptions to remove the unnaturally high fuel loading. Fuel reductions include various combinations of understory thinning, slashing, piling, and/or prescribed burning. Most prescribed burning occurs in the moister and cooler time of the year to avoid escapement risks and smoke concerns. Spring/winter burning may increase the chance of direct mortality of Siskiyou Mountains salamanders during a time of

year when they are active above the surface and vulnerable to fire. See the Appendix for further information and considerations that may be applied in landscapes with faster fire return intervals. In addition these types of fuels reduction activities may contribute to the long-term persistence of the species by reducing the potential for stand replacement fire, which likely has a higher potential for adverse effects to the species than the fuels reduction activities may have.

Conservation Status

In the Final Supplemental Environmental Impact Statement (FSEIS) and Record of Decision (ROD) to Remove or Modify the Survey and Manage Standards and Guidelines, assumptions were made as to how former Survey and Manage species would be managed under Agency Special Status/Sensitive Species policies. Under the assumptions in the FSEIS, the ROD stated “The assumption used in the final SEIS for managing known sites under the Special Status Species Programs was that sites needed to prevent a listing under the Endangered Species Act would be managed. For species currently included in Survey and Manage Categories A, B and E (which require management of all known sites), it is anticipated that only in rare cases would a site not be needed to prevent a listing. For species currently included in Survey and Manage Categories C and D (which require management of only high-priority sites), it is anticipated that loss of some sites would not contribute to the need to list. Authority to disturb special status species sites lies with the agency official that is responsible for authorizing the proposed habitat-disturbing activity” (USDA and USDI 2004). In the southern portion of its range, this species was a Survey and Manage Category A species. In the northern portion of the range, (Region 6 and Oregon State BLM), the species was Category D. The above assumptions apply to this species’ management under the agencies’ SSSSP.

Currently, this species is considered a sensitive species by both Region 6 Forest Service and Oregon BLM. Given that this species is long-lived, has a low reproductive rate, vagility, and genetic diversity, and is a habitat specialist, there are concerns as to the potential effects on populations from both anthropogenic and natural events. The known distribution of the Siskiyou Mountains salamander is geographically very restricted with a small portion of the range within reserve lands (18% in Region 6 and WA/OR BLM). Within this area sites are fairly well-distributed. The life history and ecology of this species makes it especially vulnerable to changes in its habitat, in particular changes that may affect microhabitat conditions such as timber harvest and stand-replacement fire. The low genetic diversity of the Applegate populations may also make them vulnerable to demographic stochastic events such as disease.

Very recent management practices have likely had limited effects to the species however; there may be a lagging effect from past activities that are still impacting populations. Current land management projects are generally providing mitigations for the species; also land management actions have recently focused on thinnings and fuel reduction work. Given that most of the known range is within Northwest Forest Plan non-reserve land allocations, future land management activities could potentially impact significant amounts of suitable habitat within the known range; existing SSSS policy applications will continue to be used to address

these potential impacts. In addition, large scale wildfire is likely of high concern for this species. Due to many years of fire suppression and the loss of natural fire return intervals, a large portion of the known range is currently at high risk for stand replacement fire which could severely impact known populations.

There is currently enough information of the life history and knowledge of known sites and habitat for this species such that a Conservation Strategy could be developed in that portion of the range.

Known Management Approaches

Prior to 1990, there was little management specific to this species. In 1973, a study to delineate the range and determine the effects of a proposed dam and reservoir in the Applegate Valley was conducted by the University of Michigan (Nussbaum 1974). This study expanded the known range, number of occupied sites, and the understanding of suitable habitat for the species significantly. However, there was no mitigation implemented for this species during the project. Significant timber harvest occurred within the range of the species in the 1970s and 1980s and there were undoubtedly impacts to the habitat of this species. Using suitable soil types (soil types with > 60 percent rock content) as a basis for projecting potential habitat, 10% of the total potential habitat (10,000 acres, 4,047 ha) on the Applegate Ranger District, Rogue River National Forest, had been harvested between 1984 and 1994 (D. Clayton, unpubl. data). Beginning in the early 1990s, the Forest Service and BLM began to survey for populations and to manage known sites, ostensibly by avoiding all impacts to those sites. That type of management generally continued until 2004. No assessment as to the effectiveness of this management approach was conducted; there has been, to date, no research or monitoring to evaluate effective size of management/protection buffers.

Management Considerations

As projects are proposed on federal lands, field unit personnel should identify sites to be managed for species persistence in accordance with agency policies. Given the high number of sites for this species, not all sites are likely to require management in order to provide for species persistence.

For sites identified for management, the following are suggested considerations to help meet policy objectives, and maintain the site. Because the Grider Group occurs entirely within Region 5 of the Forest Service, these management considerations apply only to the Applegate group of the Siskiyou Mountains salamander.

Each site identified for management should be assessed at the site-specific level both for habitat protection and potential restoration measures, although management considerations can be developed for the entire range of the species. The variety of site conditions, historical and ongoing site-specific impacts, and population-specific issues warrants consideration of each site individually.

Methods to identify occupied sites for management to meet agency specific policy goals may involve surveys in areas of high conservation concern or locations with limited knowledge of species distribution or abundance patterns, or utilization of existing known site data for development of conservation strategies in areas with substantial site location knowledge where every known site may not need protection.

A large portion of the known range of this species occurs within the Applegate AMA, where action-based planning, monitoring, and research is encouraged with the objective of improving implementation and achieving the goals of the standards and guidelines of the Northwest Forest Plan. Given the relatively large number of locations of this species, the current known distribution, and the genetics of the species within the AMA, there are opportunities to test assumptions as to the habitat requirements, and effects of land management activities on the species. A primary area of interest is how fuels management and current timber management practices impact this species, and what types of mitigation may be employed to reduce the risk to the species sites while still implementing the projects. .

To maintain an occupied site, an understanding of the site-extent and habitat quality is needed. Occupied habitats range from small rock outcrops to entire hillsides. For large sites, species management may vary across the site such that areas of conservative protection are identified, as well as areas for restoration or for management activities that have a higher risk to salamanders or their habitat integrity. The goal of managing these large sites would be to maintain the overall site, not necessarily each individual. To assess site extent, surveys may be conducted or the site extent can be visually estimated. For an estimate, once the presence of Siskiyou Mountains salamander has been determined at a site, all similar habitat contiguous with the site may be included as part of the site; occupancy may be assumed for contiguous similar habitat unless information demonstrates otherwise. Maintenance or restoration of optimum habitat patches might be considered. Spatial heterogeneity in surface rock, vegetation, microclimate, and the lack of illumination in June (as determined by aspect and topography) may also be used to qualitatively assess habitat suitability for these ground-dwelling salamanders (See Figure 2).

Management activities in areas adjacent to known sites may be evaluated with regard to their affect on habitats and populations of Siskiyou Mountains salamanders. Exactly how edge effects may interact to affect suitable microclimate conditions for salamanders is unknown. Also unknown are the variances that may occur with different sorts of forest edge conditions (i.e., not all edges are clearcuts). Occupied sites that abut federal reserve land allocations (e.g., botanical reserves, owl cores, riparian reserves) with similar suitable habitat conditions for salamanders may provide larger areas for subpopulations, habitat connectivity to other sites, and reduce fragmentation of the animal subpopulations across the landscape. Managing sites for the maintenance of well-distributed populations may require this expanded look of the position of sites and habitats across land allocation and ownership boundaries. Also, an understanding of the variety of land management activities predicted to occur on each allocation relative to their impacts on salamanders and their habitat needs is important. A minimal or short-term risk may

be inappropriate at a small, isolated population, whereas it may be possible in part of a large occupied habitat.

Specific Considerations

Maintenance of substrate and vegetative integrity at Siskiyou Mountains salamander sites is important and should be considered for this species. Maintenance of the integrity of stabilized talus and associated rock outcrops should be considered so that cool, moist microclimate conditions are maintained. Retention of canopy closure is likely important in the maintenance of sub-surface microclimates needed by this animal.

For land-use practices proposed within Siskiyou Mountains salamander sites, consider the seasonal activity patterns of this species. Disturbance of animals and their habitats during wet periods (fall/spring), when animals have increased surface activities, could result in direct mortality to individuals. A seasonal restriction for any ground disturbing activity could be implemented during October 1 to May 30 to reduce direct mortality of animals. Exact dates of a seasonal restriction can vary, based on local conditions. In addition it is possible to conduct activities during the winter as these animals retreat to below-surface refuges during cold conditions. If conditions remain dry in the fall, surveys could be considered to determine whether or not the animals are active at the surface. If they are not, activities could continue.

Considerations for management of this species within the Wildland-Urban Interface (WUI) are found in the Appendix.

V. Inventory, Monitoring, and Research Opportunities

Data and Information Gaps

Additional data are needed to refine microhabitat and microclimate conditions suitable for this species. Both monitoring and research studies may contribute to knowledge gaps. In particular information is lacking in these major areas:

- Microclimate conditions required by the species in surface and subsurface refugia, and microclimate changes with vegetation management, including edge effects.
- The response of the species to various land management activities that typically occur within the range of the species, including timber harvest activities (density management and regeneration harvest) and natural and prescribed fire.
- Reproduction, movement, dispersal, and foraging behavior.
- Geographic boundaries of discrete populations, and connectivity among populations.

- Effects of multiple hazards or risks to species across landscapes and populations.
- Species' role in communities and ecosystem processes

Inventory

Survey approaches may vary. A standardized survey protocol has been developed to help assess Siskiyou Mountains salamander presence prior to habitat disturbing activities associated with land management and is currently being reconfigured for the Special Status and Sensitive Species program (Clayton et al. 1999). This protocol outlines survey procedures and environmental conditions that optimize detection probabilities. Surveys using this protocol may assist biologists with some of the information gaps such as microhabitat and environmental conditions required by the species as well as basic answers to the potential effects of various land management activities on the species. The standardized protocol is also a useful tool to help determine presence/absence of the species as part of project evaluation work.

For studies that address such questions as species-habitat associations, long-term effects of timber harvest, and other activities, movement or occupancy patterns, other types of inventory or research may be needed. This type of work will have additional inference to the sampled population if random site selection is used. Nonrandom site selection results in case studies with implications only to the sampled sites; biased samples and results may occur. Pitfall trapping and mark-recapture methods may be effective approaches for long-term site or population studies (Heyer et al. 1994). The success of artificial cover boards to survey for terrestrial salamanders has been limited in xeric forest habitats of southern Oregon such as those occupied by *P. stormi*. Nocturnal surveys may also be effective, but may be hazardous to surveyors in remote areas.

Monitoring

Tracking of land management activities at sensitive species' sites can enable monitoring and adaptive management relative to species management objectives. If impacts to sites occur, annual accomplishment reporting could be considered, and electronic data entry in GeoBOB/NRIS provides a standard format for documentation. Complete all applicable GeoBOB/NRIS data fields (e.g., site management status, non-standard conservation action; threat type; and threat description). With later monitoring, impacts to habitats or species can be recorded into GeoBOB/NRIS or other local or regional sensitive species databases in order to facilitate persistence assessments.

As part of a Regional monitoring plan, resurveys of past-populations are needed, in addition to both implementation and effectiveness monitoring of past management actions. Monitoring can address important questions: Have populations changed in the last few decades? How has land-use changed in the area over the last twenty years? What population-specific threats were present in the 1970's, and how have they changed today? Do current timber practices threaten

this species at the same level as previously perceived? What protective measures have been implemented, and what were the results of this management? Long term monitoring of known sites as well as sites that have had management activities occur within them can give insight into population trends and long term effects to populations that have experienced various types of management.

Ongoing monitoring of current-populations and the implementation and effectiveness monitoring of currently-imposed protective measures also are needed. These may be accomplished through a Regional coordinating body, or through partnerships with research agencies. What are the recognized hazards, exposure to hazards, and risks to animals or habitats at each locality and for each population? How is management addressing each identified scenario of hazards, exposures, and risks per site or population? How can hazards be reduced over the long term in highly sensitive areas? Do current trends in area timber harvesting, roading, or excavation need to be more directly addressed? Rather than always focusing on site-specific management, can the results of compiled risk analysis be used to generate long-term area management goals?

Research

The data gaps discussed above each relate to needed research on this animal. The microclimate requirements of these animals are of particular interest. Site considerations for this species should address microclimate conditions because this is conceptually of high importance, yet there are no data demonstrating this is an important limiting factor for these animals in a managed forest landscape. In addition, there is little information on how various management practices may affect microclimates or populations of these salamanders. It is also of particular importance to investigate gene flow capability among discrete lineages, and to determine lineage boundaries. Reproduction, movement, dispersal, and foraging behavior in this species are also important areas of research. Studies that employ mark-recapture techniques could be useful in answering questions such as do these salamanders disperse and how far do they go?

The use of the federal GeoBOB/NRIS databases will allow several questions of the spatial distribution of this species to be addressed for the development of landscape-level design questions and the further assessment of habitat associations. The literature also lists sites at which no salamanders have been found during previous surveys. If these unoccupied sites were also mapped, relationships in salamander distributions relative to the spatial distribution of rocky substrates, rock outcrop size, vegetation types, slope, aspect, topography, elevation, riparian areas, land allocation, land ownership, historical disturbances, and current disturbances could begin to be assessed. A risk assessment is being developed between these factors and the long-term persistence of populations to assist in answering such questions as: are there populations or areas where stronger or relaxed protective measures may be warranted, or where adaptive management might be attempted? Development of strategies to address these questions of conservation biology is a critical research need.

VI. Acknowledgments

For stimulating discussions regarding salamander conservation, we would like to thank members of the Siskiyou Mountains salamander working group and the former Survey and Manage Amphibian Taxa Team, including Brenda Devlin, Ed Reilly, Hart Welsh, Lisa Ollivier, Steve Morey, Charlie Crisafulli, Larry Jones, and John Guettermann. We are particularly grateful for comments on previous federal known site management recommendations for this species from a host of both resource managers and species-experts. We have sincerely enjoyed working with all of the great people in the Survey and Manage Program over the last ten years.

VII. Definitions

Persistence

The likelihood that a species will continue to exist, or occur, within a geographic area of interest over a defined period of time. Includes the concept that the species is a functioning member of the ecological community of the area.

Site (Occupied)

The location where an individual or population of the target species (taxonomic entity) was located, observed, or presumed to exist and represents individual detections, reproductive sites or local populations. Specific definitions and dimensions may differ depending on the species in question and may be the area (polygon) described by connecting nearby or functionally contiguous detections in the same geographic location. This term also refers to those located in the future.

Oregon and California Natural Heritage Program Definitions

Globally Imperiled

G2 – Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6-20 occurrences.

G3 – Rare, uncommon, or threatened but not immediately imperiled, typically with 21-100 occurrences.

Q – Questionable taxonomy

State Imperiled

S1 – Critically imperiled because of extreme rarity or because it is extremely vulnerable to extinction, with 5 or fewer occurrences.

S2 - Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6-20 occurrences.

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Personal Communications

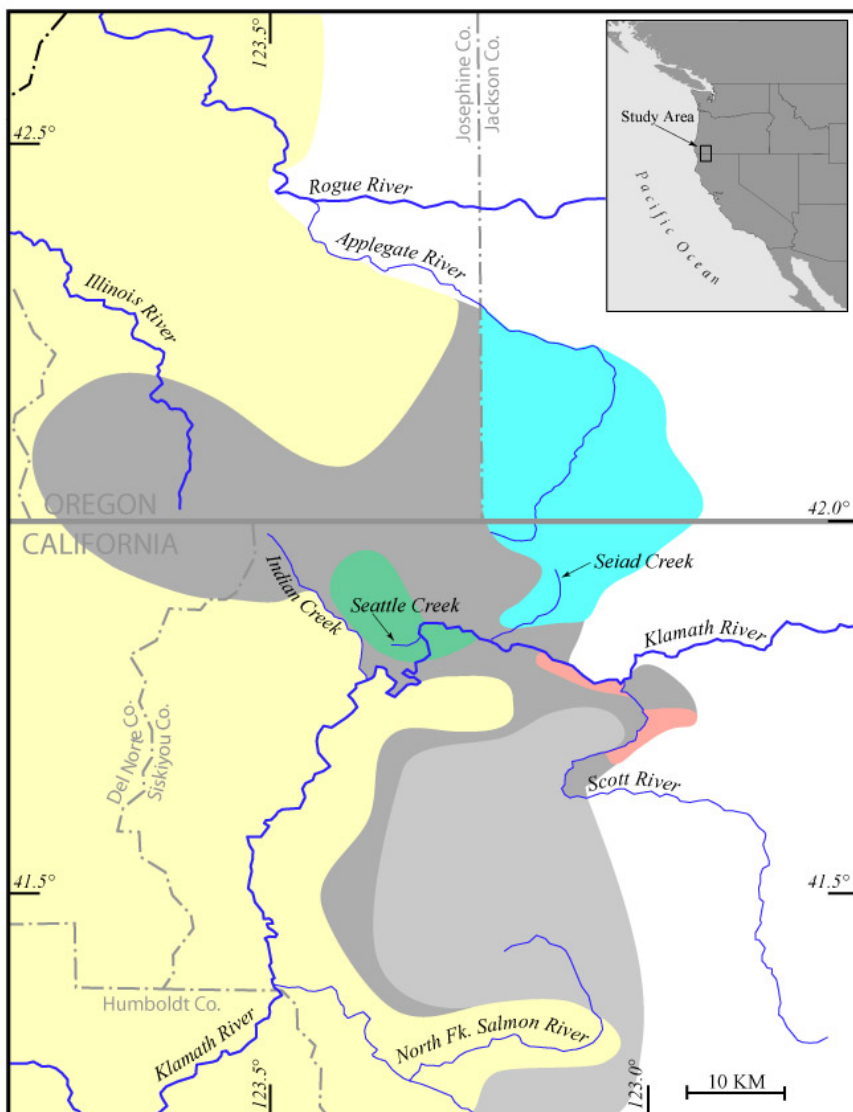
Dr Louise Mead

University of California at Davis, Davis California

Ed Reilly

Medford District of the Bureau of Land Management, Medford Oregon.

Figure 1 MAP OF KNOWN AND SUSPECTED RANGE

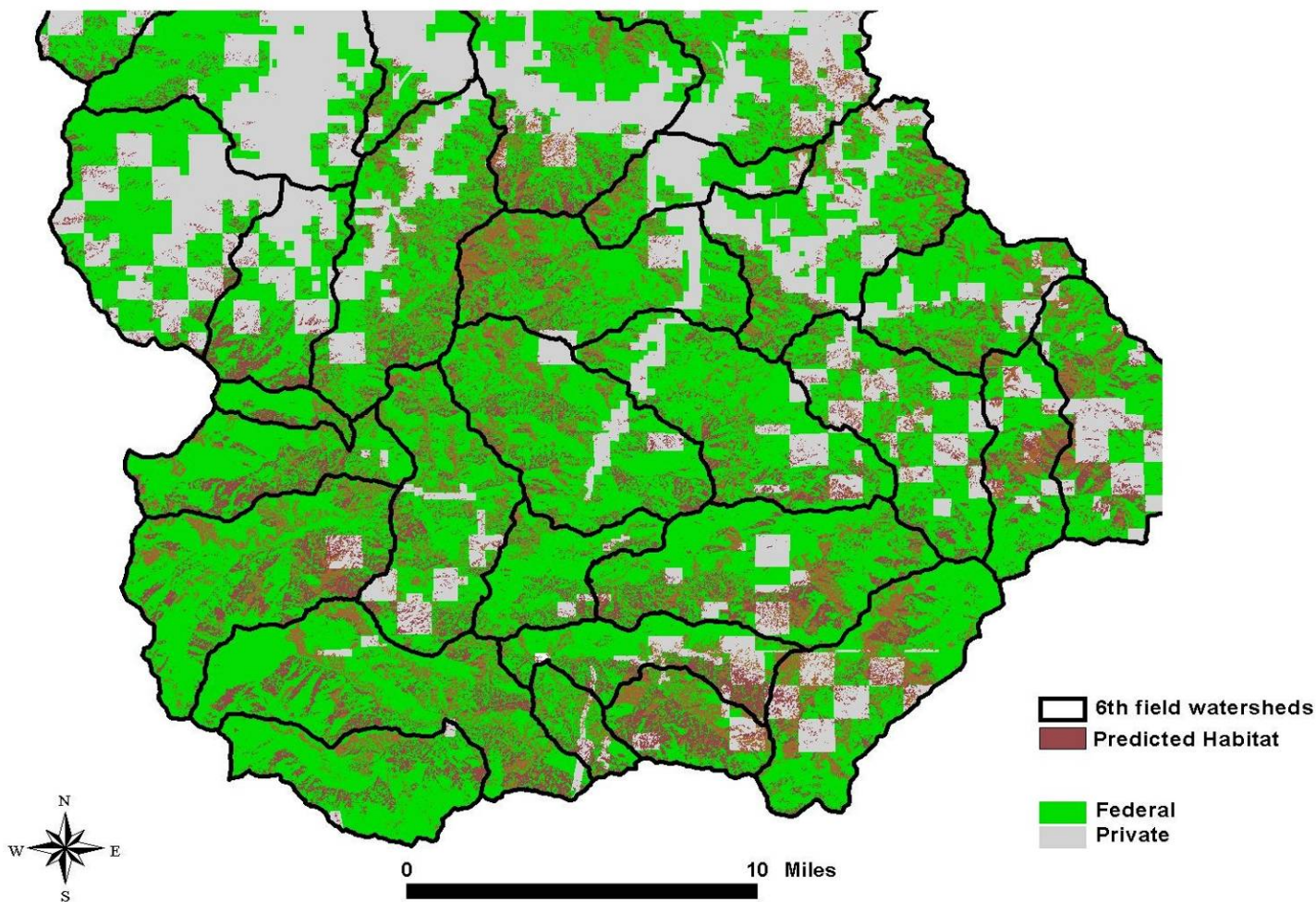


Draft Map of *Plethodon* mtDNA clades. Dark Gray areas represent known *Plethodon* range and light gray represents potential range. Mahoney (2004) and Mead et al (in press) were the primary sources used to create distributions. Selected points cited as unpublished data in DeGross (2004) were used primarily along the west side of Indian Creek.

The dark gray portion of the range in Josephine County (west Applegate Valley and the east Illinois Valley) shows the known *Plethodon* range but it is not confirmed by genetics which species occurs in that portion of the range.

Figure 2

Plethodon stormi Habitat



APPENDIX

Managing for the Siskiyou Mountains Salamander (*Plethodon stormi*) in Fuel Treatment Areas around At-Risk Communities.

The following information and management considerations apply only to the Applegate population of the Siskiyou Mountain salamander. The Applegate Group is the largest group with the most extensive range and number of sites. Consequently, a flexible approach to fuels management may be appropriate. This appendix should be used in conjunction with the information presented in the conservation assessment.

For the Siskiyou Mountains salamander, the Applegate known sites were evaluated relative to our knowledge of distinct populations (Pfrender and Titus, 2001, Degross 2004). Persistence of this distinct population on federal lands was evaluated to address potential activities that might not pose a risk to site persistence and also to potential sites where activities with a high risk to site-level persistence would not compromise population-level persistence. Also taken into consideration during this persistence evaluation was the knowledge that current known sites identified within the GeoBOB or NRIS databases for this taxon usually are point localities of individual detections.

For the purposes of these management considerations, the definition of a known site includes all suitable habitat (rocky, forested habitat) contiguous with the occupied site. If the full extent of the occupied site has been delineated, apply the following considerations to that delineated area only. In particular, our knowledge of contiguous suitable habitat blocks within the northern half of this species' range suggests that sites within the radius of at-risk community fuels management may often extend a fair distance beyond those areas of proposed treatment. Management for fuels treatment may often affect only a portion of the species' site. A high risk to a portion of that species' site may not result in loss of that site.

Management Considerations

The following considerations would likely create a “low risk” to species sites. These considerations are specific to the 1 to 1½ mile fuel treatment zone (including the critical first 300 feet) surrounding developments and structures associated with a community. Treatments would not likely lead to a need to list.

Applegate Group - One general approach for addressing fuels management at known sites within at-risk communities is a 3-pronged, hierarchical approach involving maintenance of canopy, limited ground disturbance, and seasonal restrictions. This approach allows flexibility for management while maintaining a “low risk” to the species at the site level. .

- 1) To retain suitable microclimatic conditions for salamander survival and reproduction, maintain >70% canopy closure on at least 80% of the known site and maintain no less than 40% canopy closure on the remaining 20% of the known site. The percent of habitat affected may be determined in either of two ways:
 - a) 20% of the known site and the contiguous suitable (rocky, forested) habitat within the unit boundary or project area, or;
 - b) 20% of the full extent of the known site and contiguous suitable habitat, including consideration of contiguous habitat that extends beyond the project boundary.

Note: The 70% canopy closure guideline stems from research results of salamander occupancies with forest condition and should be measured using a concave spherical densiometer (Ollivier et al 2000).

- 2) To retain suitable microclimatic and substrate conditions for salamander survival and reproduction, avoid ground disturbance on 80% of the known site. Activities that displace, compact, or otherwise disturb the substrate either by heavy machinery or by yarding of logs or similar activities would occur on no more than 20% of the known site.

Note: The "20%-rule" relative to ground disturbance is based on expert opinion as well as policy for maximum allowable levels of ground disturbance in the R-6 Forest Service Manual Supplement 2520.3 and Bureau of Land Medford District Soils Management Guidelines (George Arnold pers. comm.).

- 3) To reduce direct impacts to animals, it is recommended that habitat or ground disturbing activities and burning occur when salamanders are **not** surface-active, which is from late spring through early fall (in fall, before 1.5 inches of rain falls), or when environmental conditions are "out of protocol" (e.g., in winter, after freezing, temperatures when animals are unlikely to be near surface).

Canopy reduction below 70% and total ground disturbance is cumulative across all treatments, activities, and seasons of project implementation. In other words, the impacts of any combination of activities that would reduce canopy or disturb the substrate need to be 20% or less of the known site.

Activity-Specific Considerations

To maintain a low-risk to an occupied site, consider the following:

- *Broadcast/Understory Burning* – This activity can occur within the entire known site. For reduced effects to microhabitat elements within known sites, utilize "cool" burns with short flame lengths (generally less than 2-4 feet), maintaining at least 50% of the duff layer and all possible large woody-debris post-burn. If possible, leave areas of suitable habitat within the known site unburned.
- *Hand Piling*- Avoid hand piling to the extent that the actual piled material would cover more than 20% of a known site. Machine piling is not recommended at a known site; however, if necessary, limit ground disturbance to 20% at known sites.
- *Pile burning*- Within known sites attempt to burn piles during mid-winter during freezing events, late spring, or early fall, when animals are not surface active. In coastal areas where winter freezing is rare attempt to burn piles outside of conditions when animals are surface active (late spring to early fall).
- *Pruning*- Within known sites there are no mitigations suggested for this activity unless pruning is done using heavy machinery. If so, consider the above mitigations.
- *Understory Thinning* - Within known sites canopy closure mitigations do not need to be considered for manual thinning of suppressed understory trees and ladder fuels. Apply ground-disturbance mitigations (20% of a known site) for all activities associated with mechanized understory thinning (yarding, temporary road construction, landings, etc).
- *Chipping* - Within known sites there are no mitigations suggested for this activity unless the machine is hauled into a known site by heavy equipment. If so, then consider the ground disturbance mitigations listed above (ground disturbance limited to less than 20% of the known site).
- *Raking* - Within known sites there are no mitigations suggested for this activity.
- *Hand Firelines* – Limit hand firelines at known sites to 20% of the known site.

The following considerations may result in some risk of the loss of sites, but would not likely lead to a need to list under the ESA: These considerations are specific to the 1-1 ½ mile fuels treatment zone (including the critical first 300 feet) surrounding developments and structures associated with a community,

- **Applegate Group** –For 6th field watersheds with 5 or more known sites, high risk treatments that could result in the loss of a site could be applied to up to 20% of the known sites. The amount of suitable habitat (unsurveyed and/or occupied) within those sites treated should not constitute more than 20% of the total suitable habitat (unsurveyed and/or occupied) within that 6th field watershed.

A review of the currently known sites, suitable habitat, and the communities-at-risk to which these management considerations could apply indicate that the potential loss of up to 20 percent of the suitable habitat or sites would not pose a significant risk to species persistence. There are relatively few 6th field watersheds that occur within the 1 to 1½ mile fuels treatment zone, in fire regime 1, 2, and 3A areas, that are within condition class 2 and 3, and have 5 or more known sites. Consequently relatively few sites within the range of the species would potentially be impacted. In addition, no unique genetic material would be lost as research shows that all populations within the Applegate Group are genetically very similar (Pfrender and Titus 2001). Tracking of the sites with high risk treatments would be monitored through the review of the GeoBOB or NRIS database, tracking the new fields.

Monitoring, Reporting, and Inventory

Monitoring Considerations

Annual accomplishment reporting in GeoBOB or NRIS should include filling out all applicable data fields (e.g., site management status, non-standard conservation action; threat type; and threat description) when impacts to known sites occur. Site impacts and losses should be recorded into these databases in order to facilitate persistence monitoring.

Literature Cited

Arnold, George. Medford District BLM, Ashland Resource Area. March 27, 2002.

Ollivier, L, Welsh, H.H., Clayton D. 2001. Habitat Correlates of the Siskiyou Mountains salamander, *Plethodon stormi* (Caudata: Plethodontidae). Report to the California Department of Fish and Game, USDI Bureau of Land Management, Medford District, and USDA Forest Service, Rogue River National Forest.

Pfrender, M. E., and Titus, T. 2001. Genetic Structure, Biogeographic Patterns, and Founder Events in the Siskiyou Mountains Salamander (*Plethodon stormi*). Report to the U.S. Forest Service, Region 6, USFS Rogue River National Forest. Contract # 43-04N7-0126.