Conservation Strategy for the Siskiyou Mountains Salamander (*Plethodon stormi*), Northern Portion of the Range

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Photo by William Leonard

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This conservation strategy is the product of several years' work by a dynamic team of interagency personnel and species experts. Key contributors to the development of concepts resulting in this strategy include:

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Disclaimer

This Conservation Strategy was prepared to compile the published and unpublished information on the Siskiyou Mountains salamander (Plethodon stormi).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. If you have information that will assist in conserving this species or questions concerning this Conservation Strategy, please contact the interagency Conservation Planning Coordinator for Region 6 Forest Service, BLM OR/WA.

Executive Summary

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

Taxonomic Group: Amphibian

Purpose: This Conservation Strategy describes the management actions necessary to manage for this species to maintain well-distributed populations across the known range of the species on federal lands administered by Forest Service Region 6, Rogue River-Siskiyou National Forest, Siskiyou Mountains Ranger District, and the Oregon Bureau of Land Management, Medford District, Ashland Resource Area, in the northern portion of it's range, the Applegate River 4th field watershed, and to avoid a trend towards listing under the Endangered Species Act.

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, taxa that are threatened with extinction or presumed to be extinct throughout their entire range. Management of the species follows Forest Service 2670 Manual policy and BLM 6840 Manual direction. (Additional information is available on the Interagency Special Status and Sensitive Species website, http://www.fs.fed.us/r6/sfpnw/issssp/).

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 substrate. Using habitat associations' research, a high potential habitat map has been developed for this species in the northern portion of its range, the Applegate Valley 4th field watershed (Appendix 1).

Threats: Habitat loss, degradation, and additional fragmentation of discrete populations are all potential threats to this species. Activities that may pose threats 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 such as regeneration harvest with associated road construction and ground-based harvest systems. Other types of activities such as recreation projects, rock quarry management and construction, and prescribed as well as wildland fire may pose somewhat lesser potential threats to the species. As the majority of known sites occur on Federal lands, Federal land management activities have the highest likelihood to adversely impact the species.

Conservation elements: Sites identified for Siskiyou Mountains salamander conservation were selected by a panel of scientists and natural resource managers from records in the ISMS and GeoBOB databases. These sites are referred to as "high-priority" sites. The potential role of a site was reviewed at the Applegate River 4th field watershed, 6th field watershed and individual site scales. At the Applegate River 4th field watershed scale, each site was evaluated based on the distribution of known sites, federal land allocations, the predictions of a habitat model, and the predicted risk to persistence from natural (fire) and anthropogenic disturbances. Within each 6th field watershed, sites were selected for protection to reduce extinction likelihood within the watershed and to contribute to well-distributed, interacting sub-populations. When possible, we selected localities that occurred in or near existing federal reserve land allocations as defined in the Medford District Resource Management Plan and the Rogue River National Forest Land and Resource Management Plan. Land allocations include large LSR owl cores, botanical set-asides, and riparian reserves.

This Conservation Strategy covers all or part of 19 6th field watersheds within the Applegate River watershed. Within these watersheds, 110 ISMS/GeoBOB site locations were identified as high-priority (range 2-12/watershed) for long-term site protection. A preliminary delineation of these high-priority sites was conducted using existing maps of habitat elements. Field units will review and refine the final delineation of high-priority sites during project planning.

One of two management strategies is recommended for each high-priority site. The first strategy focuses on maintaining habitat conditions for this species at the high-priority site by limiting activities that may have adverse effects on substrate, ground cover, forest condition, or microhabitat and microclimate. The second strategy allows for greater latitude in activities at the high-priority site by applying the existing Fire Management Recommendations to the high-priority site. The 2-tiered approach attempts to integrate the fire ecology of the area, current stand conditions, fuel loads and proximity to populated areas while providing for the long-tem persistence of Siskiyou Mountains salamander populations.

Inventory, Research, and Monitoring

Data and information gaps for this species include:

- Some gaps in known site distribution within the known range in the Applegate Valley.
- The potential effects of fuels treatments within suitable habitat and high priority sites.
- 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.
- Geographic boundaries of discrete populations, connectivity among populations, and connectivity among selected high priority sites.
- Effects of multiple hazards or risks to species across landscapes and populations.

Inventory and Monitoring Guidelines:

- Inventories will be conducted to fill gaps in distribution, and assess habitat conditions and salamander occupancy in areas with planned projects in order to finalize high priority site selection within 6th field watersheds.
- Implementation monitoring will include an annual compilation of projects conducted, and priority sites selected for the two management strategies.
- Effectiveness monitoring projects will be developed for each 5-year interval to assess success of the two management strategies in retaining species at priority sites, and assumptions of the Conservation Strategy including the occupancy of animals in areas other than high priority sites.

Adaptive Management:

A review of this conservation strategy will be conducted every five years, where new species knowledge, science findings, habitat information, and strategy implementation are evaluated. Revision of the Conservation Strategy may follow the 5-year reviews to refine the plan or address emerging issues.

Between the 5-yr reviews, the following may trigger an immediate review:

- A significant change in the number of known sites within a sixth field watershed so that the understanding of the distribution of the species has changed to the extent that sites may be added or re-prioritized.

- A significant range change or extension has occurred such as a site found north of the Applegate River or in another 6th field watershed not previously known to harbor the species.

- Significant changes in Forest Service or BLM Land-Use Allocations as determined by the field unit, within the area of the conservation strategy or a significant management direction change on Federal lands within the area of the conservation strategy.

- A significant change in habitat conditions due to large-scale fire that may change our assumptions as to the amount of habitat available and contributing to the persistence of high-priority sites identified within the conservation strategy. This might occur when more than half of one 6th field watershed occupied by the species is affected by the disturbance.
- New science that changes our understanding of the ecology of the species or its habitats.

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I. Introduction

Goal

This Conservation Strategy describes the management actions necessary to maintain a high likelihood of well-distributed populations across the , northern portion of the Siskiyou Mountains salamander's range, within the Applegate River 4th Field watershed, on federal lands administered by the Rogue River-Siskiyou National Forest, Siskiyou Mountains Ranger District, and the Oregon Bureau of Land Management, Medford District, Ashland Resource Area, in the northern portion of it's range, the Applegate River 4th field watershed, and avoid a trend toward federal listing under the Endangered Species Act.

For Oregon Bureau of Land Management (BLM) administered lands, SSS policy details the need to manage for species conservation. Conservation is defined as the use of all methods and procedures which are necessary to improve the condition of Special Status Species and their habitats to a point where their Special Status recognition is no longer warranted. In addition, implementation of the policy is intended to ensure that actions funded, authorized, or carried out by the BLM do not contribute to the need to list species under the Endangered Species Act.

For Region 6 of the Forest Service, Sensitive Species 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 should also preclude a trend towards federal listing, for any identified Sensitive species.

This Conservation Strategy provides the most up-to-date information known about this species including life history, habitat, and potential threats. This information has been compiled from range-wide studies. 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. Additional information is available on the Interagency Special Status Species website (http://www.fs.fed.us/r6/sfpnw/issssp/)

Scope

The geographic scope of this Strategy includes the range of the species coincident with Forest Service Region 6 and Oregon BLM lands, including the Rogue River-Siskiyou National Forest and the Medford District of the Bureau of Land Management. This area is encompassed within the 4th field Applegate watershed. However, background species information is compiled for the entire species range which includes both Oregon and California in Jackson and Josephine Counties in Oregon, and Siskiyou County in California. In California the Klamath National Forest is within the range.

Management Status

The Siskiyou Mountains salamander is identified 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, taxa that are threatened with extinction or presumed to be extinct throughout their entire range, 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.

In recent years, this species has had variable consideration in two other federal rare species programs. First, from 1994 to 2004 and from 2006 to present, this species was included on the federal Survey and Manage list, a component of the Northwest Forest Plan (USDA and USDI 1994). The Survey and Manage program was eliminated in 2004 (USDA and USDI 2003, 2004), then reinstated by court order in 2006. At this writing, a Final Supplement to the 2004 Supplemental Environmental Impact Statement to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines has been released (USDA and USDI 2007), and the preferred alternative again removes the Survey and Manage standards and guidelines from federal land and resource management plans. A Record of Decision and court ruling on this are pending. Second, in 2004, this species was petitioned for listing as Threatened or Endangered under the US Endangered Species Act. In April 2006, the US Fish and Wildlife Service released a finding that listing was not warranted. This was reversed in March 2007, whereupon a 12-month review was initiated to determine if listing is needed.

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 specifically to California, in a small area north and south of the Klamath River immediately east of Happy Camp.

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. 2005), 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.

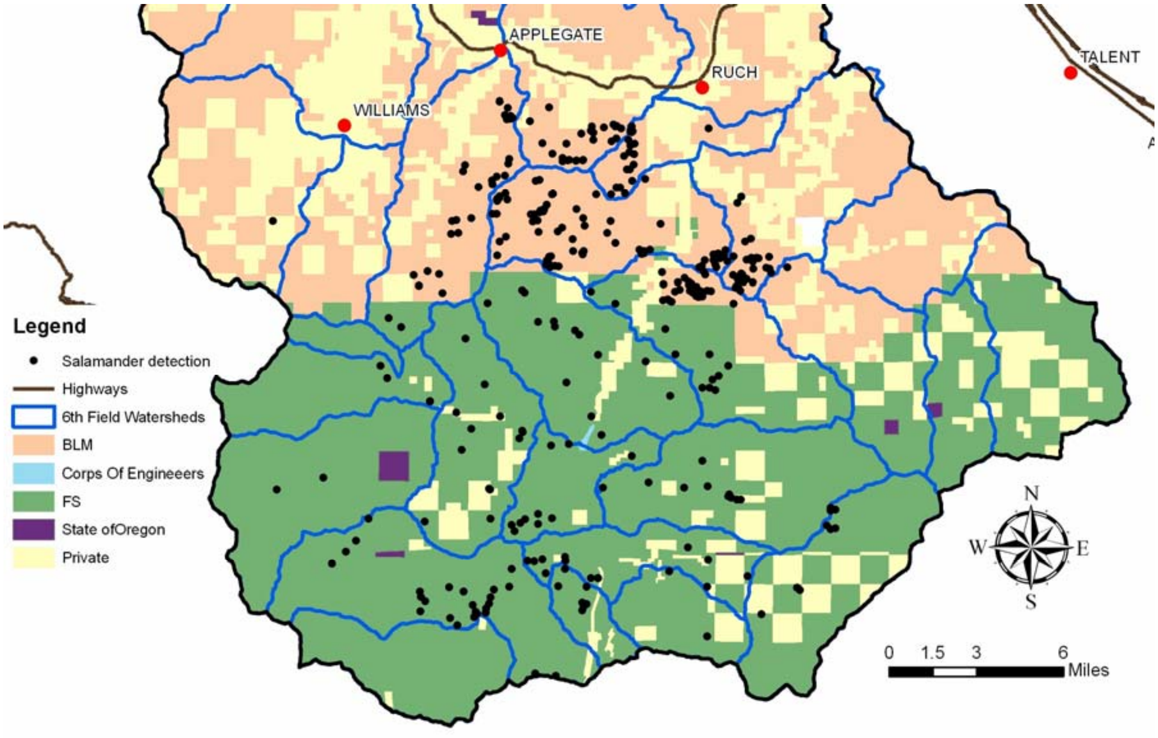
Range, Distribution, and Abundance

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 approximately 380 localities known for the species (USDA and USDI 2006, 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. In the Applegate Watershed covered by this Conservation Assessment, there are 201 sites on BLM lands (191 on O&C lands), 115 sites on Forest Service lands, and 14 sites on private lands. 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 Resource Area, the Applegate Ranger District of the Rogue River-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 watershed 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 in California, site distribution is primarily on reserve lands (67%), with 31% of sites on Matrix land. This Conservation Strategy covers only the northern portion of the range within the Applegate Valley 4th field watershed.

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).

Figure 1: Distribution of known sites of Siskiyou Mountains salamanders in the Applegate watershed, the area covered by this Conservation Strategy.



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/m^2, Ollivier et al. 2001). Nauman and Olson (2004) reported an average of 0.01 salamanders/m^2 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

Nothing 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 appear to 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, Welsh et al. 2007). Welsh et al. (2007) considered mature to late-seral forest stands to provide optimal conditions for this species. 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. Welsh et al. (2007) utilized an "illumination" index of topographic shading to help describe occupied sites. 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 also has been associated with the presence of Siskiyou Mountain salamanders (Ollivier et al 2001, Welsh et al. 2007). 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, deep litter, the number of hardwood trees and years since disturbance (Ollivier et al. 2001, Welsh et al. 2007) are associated with salamanders because they likely 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. Their general ecology and life history traits suggest they are ideal indicators of forest ecosystem integrity as many are associated with mature forests (Welsh and Droege 2001).

IV. Conservation

Threats

Optimal habitat for these animals includes late-seral forest conditions with rocky substrates and cool, moist microclimates (e.g., Welsh et al. 2007). 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

Timber harvest is the primary current land management practice in forested ecosystems in this geographic region. Several disturbances of salamander habitat conditions 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 refugia 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 (e.g., 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 clearcut 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) regeneration harvest units 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).

Alternative silvicultural practices may not always have adverse effects on the ground-dwelling salamander assemblage. Messere and Ducey (1998) found no significant differences in abundance of northern red-backed salamanders in forest canopy gaps in stands that had been selectively logged in New York, indicating that limited logging may have little effect on that species. In contrast, Knapp et al. (2003) found reduced abundances of terrestrial salamanders in stands with leave tree, group selection or shelterwood cuts, compared to uncut stands in Virginia and West Virginia.

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. More recently, Karraker and Welsh (2006) found clearcutting affected plethodontid numbers up to 25 years post-harvest in northwestern California. Karraker and Welsh (2006) also found similar abundances of plethodontid salamanders in thinned and unthinned forests, but body condition of most species was lower in thinned stands. Rundio and Olson (2007) found reduced abundances of plethodontid salamanders following thinning at one of two study sites, and suggested site conditions (e.g., down wood, substrate) may have ameliorated effects of canopy reduction at one site.

Although no published studies address the direct affects of timber harvest activities on the Siskiyou Mountains salamander using a well-designed approach with pre- and post-treatment data and reference stands, 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). These data are inconclusive but may indicate some recolonization of the site or a sink habitat into which individuals are dispersing from a nearby source habitat and may not subsequently survive.

Federal timber management practices have changed significantly, since most studies of timber harvest effects on amphibians have been conducted. 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 are still likely, but must meet agency standards, generally less than 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, and to access timber harvest operations. 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 exclusion 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 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 intervals and high intensity fires 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 reduction prectices 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. However, 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.

Species Conservation Objectives

The objective of this Conservation Strategy is to provide for a high likelihood of long-term persistence of well-distributed populations of Siskiyou Mountains salamanders within the range of the species in US Forest Service Region 6 and Oregon BLM lands and to avoid a trend toward federal listing under the Endangered Species Act.

Applegate Watershed 4th field range-wide scale objectives

1) Maintain viable populations such that there are sufficient numbers and distribution of reproductive individuals to ensure their continued existence within the Applegate River 4th field watershed.
2) Provide well-distributed habitat to support reproductive individuals that can interact in the planning area.
3) Utilize the existing federal reserved land allocations as a foundation for providing a high likelihood of continued species persistence.
4) Minimize impact to federal non-reserve land allocations and other resources when possible.

Intermediate scale objectives

1) Provide for the maintenance of Siskiyou Mountains salamanders within each 6th field watershed where they occur within the Applegate River 4th field watershed.
2) Within 6th field watersheds, establish finer-scale assessments of need for restoration and protective approaches.
3) Within 6th field watershed, select sites to manage for long term conservation (high-priority sites) based upon location of animals and criteria including suitable habitat, risk factors, federal land allocations, and proximity to other sites such that protections are tiered to population rarity, risk to persistence and connectivity potential.

Site scale objectives

1) Establish initial extent of selected high-priority sites from existing known site, habitat, geographic and topographic data.
2) Consider fire ecology, stand conditions and the distribution of existing reserves when designing management guidelines for each high-priority site.

Underlying Assumptions and Definitions

Reference Distribution: The reference distribution of a species needs to be identified in order to develop strategies to provide for well-distributed populations. The term “well-distributed” is defined as the “distribution sufficient to permit normal biological function and species interactions, considering life history characteristics of the species and habitats for which it is specifically adapted” (USDA and USDI 2001, p. 86). “Well-distributed” may be inferred from the historic (prior to European settlement) distribution (USDA and USDI 2000, p. 342). The historic distribution can sometimes be derived from habitat associations, occupancy rates in suitable habitat, historic habitat distribution, potential past disturbance signatures and other knowledge about the species. If these factors are not well known and historic distribution cannot be inferred, the current distribution can be taken as the reference distribution (USDA and USDI 2000, p. 342).

For the Siskiyou Mountains salamander, the current known range is the reference distribution for species conservation objectives. While some historical locations may have been lost due to relatively recent disturbances, the species range boundaries appear to be driven by natural environmental conditions such as lack of rocky substrate or harsh microclimate conditions for salamanders. More is known today about this species' distribution than ever before. The known range has approximately tripled between 1980 and today, doubling between 1993 and 1998 (Nauman and Olson 1999). However, current knowledge is not complete and in several areas covered by this conservation strategy, surveys have not been conducted for this species. Lack of a population within a patch of apparently suitable habitat may indicate lack of surveys or lack of salamanders. New distribution information should be incorporated into this strategy by considering selection of additional known sites for conservation management, or by reconsideration of sites within an area for site re-selection.

For purposes of management of this species under FS Region 6 and BLM Oregon Sensitive and Special Status Species policies, the range-wide area under consideration for this Strategy is the 4th field Applegate watershed which includes the Rogue River-Siskiyou National Forest, Siskiyou Mountains Ranger District, and the Medford BLM, Ashland Resource Area.

Desired Outcome: The desired outcome of this conservation strategy is to provide habitats occupied by sub-populations of Siskiyou Mountains salamanders distributed across the northern range of the species within the Applegate watershed. The pattern should reflect current knowledge of occupancy rates and optimal habitat conditions, but should not neglect the range of conditions under which this organism exists. While optimal habitat conditions are desired as an outcome for each high-priority site selected, sites selected as high-priority include areas central and peripheral to the range, in low and high fire hazard zones, on ridgelines and in riparian areas, and on all aspects. The proximity of the selected high priority sites and the conditions between them should permit some gene flow, although some sub-population isolation or gaps in distribution may occur. The distribution pattern of high priority sites should reflect two additional considerations; spatial extent of historical fire disturbances in this landscape and site redundancy. Given previous fires have occurred across portions of the species range, high priority sites are chosen in a pattern that would facilitate potential recolonization post-disturbance to fire. Related to this, the concept of site redundancy was considered, particularly within or adjacent to areas of high fire hazard. The **Selection Criteria** section below fully itemizes considerations for high priority site selection.

Population demography and dynamics are not known for this animal. Thus, the decision for how much area may be needed for each site selected as high priority to maintain sub-population persistence has little baseline knowledge for guidance. However, there are existing sites that appear to occur in variable spatial extents of surface rock, ranging from a handful to hundreds or thousands of acres. In selecting high priority site areas in this strategy, conservative approaches are used, with a range of areas across each 6th field watershed selected to hedge uncertainties. Juxtaposition of high priority sites with existing federal reserves substantially boosts protected areas for potential sub-population occupancy.

The "anchor habitat concept" (e.g., Olson 1998) can be applied to this conservation strategy. This concept includes flexibility in spatial designation of habitats identified for species conservation over time, such that optimal areas for species conservation can be selected or adjusted as they become recognized (e.g., from new knowledge or from restoration of conditions over time). The anchor analogy is that the "anchor" habitat is retained but may move to new positions to best-provide for its designed purpose. The intent in the high-priority site selection process identified herein is to provide well-distributed sub-populations across the planning area; yet the recommended sites and site-delineated boundaries are now selected largely from remote sensing data of landscape attributes at the intermediate spatial scale. Field reconnaissance may result in a better understanding of ground conditions such that selected sites may move or site boundaries adjusted. Over time, as new sites are found or site conditions are changed by natural disturbances or are restored, the anchor habitats to provide for the species may again need to be adjusted. This is the key component of flexibility provided in this strategy. While over a hundred known sites have been identified in this Strategy for the goal of conservation management, and habitat conservation areas have been provided in general terms for each of these sites, ground-truthing to adjust these recommendations is expected, and new habitat or other conditions over time should result in a re-examination of high-priority site selection in some areas.

The high-priority sites identified in this Conservation Strategy are expected to anchor the population, but not to impose an artificial metapopulation over the managed landscape. This Strategy is designed so that salamanders are likely to thrive at high-priority sites, but they are also expected to persist to a large degree in federal reserve allocations with suitable habitat, and possibly in many sectors of the managed landscape having suitable habitat conditions without reserve status. Risk to persistence of salamanders in these other areas is greater due to the potential for activities that may impact populations and uncertainty, but that does not preclude their occurrence or the functional role intervening lands between high-priority sites may have for connectivity across the landscape and overall viability of the species. High-priority sites are not envisioned to be acting as island reserves across the expanse of the Applegate watershed; the risk analysis (below) speaks to this. However, this is an aspect of the strategy that may require monitoring. If intervening lands become highly disturbed and unsuitable habitat conditions predominate, connectivity to retain interacting individuals across the landscape may need to be re-addressed.

<u>Management Limitations:</u> Limitations on the capability of federal management actions to provide for well-distributed populations of this species include the following considerations. First, non-federal lands fragment some parts of the species range, and consequences of disturbances on non-federal lands for salamander persistence is only addressed by recommendations for management practices on the adjacent federal lands. Also, long-term effects on the species from federal land management of occupied salamander sites that are not chosen as high priority sites are unknown. Both federal and

non-federal land management of salamander habitats may fragment the species' range and disrupt population integrity more than is currently considered in this Strategy. Cumulative effects of federal and non-federal land management require monitoring and adaptive management. Second, due to our limited knowledge of species' distribution and population structure and dynamics, a conservative approach may be warranted for this vertebrate species. This is addressed through the numbers of sites recommended as high-priority sites which allows for redundancy and adjacency of sites and the spatial extent of these high-priority sites, in turn allowing for potentially high numbers of salamanders to occur at each high-priority site. Third, there is limited knowledge of the effects of forest management activities on these salamanders. While options for managing high-priority sites are included in this Strategy, a conservative approach to site management may be warranted until the resiliency of these animals to site-specific activities is better known. Fourth, it is acknowledged that the detectability of these salamanders may be an issue for determining occupancy patterns. Under appropriate environmental conditions for surveys, there is a chance of not detecting the salamanders when they are present at a site because they are subsurface. While this chance is not quantified, the result is that many known sites detected from single survey efforts may reflect the subpopulations with greater abundances or surface activities, and the knowledge of salamander distribution may be conservative (i.e., there may be a pattern of greater occupancy than is realized by survey detections). Finally, the region is in a zone of relatively high natural fire frequency. While that is taken into account in the conservative approach taken here, it is expected that adaptive management in terms of the strategy design or site-management approaches may be needed in response to fire locations and severity.

<u>Risk Level of the Strategy:</u> Implementation of this conservation strategy is designed to have a low to extremely low risk to the continued persistence of this species. At the site level, the recommended fuels management activities have not been examined relative to their effects on salamanders. Hence, there may be a risk of losses to individuals or subpopulations of these activities. However, the risk of sub-population extirpation is relatively low, and contrasts sharply with a higher risk of losses if a fire disturbance event were to occur and result in altered forest canopy and ground microclimate conditions. Losses of individuals from fuels reduction activities may be recouped over time as habitat conditions for salamanders likely improve due to these restoration practices. Again however, the resiliency of these salamanders to disturbances of this type has not been studied, so there is uncertainty in how well they would respond to changing conditions with time. Effects monitoring is suggested. At the intermediate scale, site redundancy and a mix of protective and restoration approaches suggests an extremely low risk to persistence. Also, disturbances from fires or site management activities are likely to be staggered spatially and temporally, and risk of losses would not occur synchronously for all subpopulations in a neighborhood. The aggregate of 19 6^{th} field watersheds allows the concepts of redundancy and a mix of approaches to be applied to the species range scale in the planning area. A large disturbance such as fire or disease may occur in the area, but it is likely that it would not have severe effects across the entire landscape due to its naturally fragmented nature and patchy occurrences of habitats and animals. Subpopulations within watersheds and sites are likely to be retained under this worst case scenario. Risk to persistence at the range wide scale is extremely low. This strategy is

designed to provide persistence for this species for at least 100 years. Risk assessment is addressed in a later section also.

Selection of Management Areas

Selection of high-priority sites for salamander conservation was conducted by a panel of scientists and resource managers, and considered existing federal standards and guidelines for the planning area, distribution of habitat, and known localities of salamanders. Potential risk factors to salamander persistence were also assessed, including fire hazard, location relative to the populated areas, proximity to other private lands and road density. In addition, maps of species richness from the federal Interagency Species Management System (ISMS) database were examined. These factors were evaluated at both the landscape and 6^{th} field watershed scales. Also digital elevation maps and aerial photographs were used as sites and watersheds were evaluated.

Federal land allocations and forest plans

The Siskiyou Mountains salamander conservation strategy builds upon the existing reserve systems and the Standards and Guidelines established under the Rogue River-Siskiyou National Forest Land and Resource Management Plan, the Medford BLM Resource Management Plan and the Northwest Forest Plan. In this area, the reserve system includes congressionally withdrawn areas, riparian reserves, owl habitat areas, botanical reserves, late-successional reserves, and special emphasis areas (Figure 2).

Not all reserved lands were assumed to provide protection for the Siskiyou Mountains salamanders. Many federal reserved areas have been managed in the past, may be managed in the future, and all are subject to natural disturbances in the future. For example, density management or fuels reduction activities in riparian reserves or late successional reserves may have adverse effects on salamanders. However, an assumption was made for this Strategy that most reserved lands will be managed in a way that is either neutral or beneficial for this species.

Before development of this conservation strategy an initial risk assessment was conducted to qualitatively assess the likelihood of persistence of the Siskiyou Mountains salamander in the Applegate watershed, based on provisions within existing federal forest plans and their standards and guides (see Risk Assessment section below). The development of this strategy was initiated due to relatively low and variable persistence likelihoods among 6^{th} field watersheds in this zone, in addition to high uncertainty regarding future management and disturbance scenarios and their effects on salamanders and their habitats.

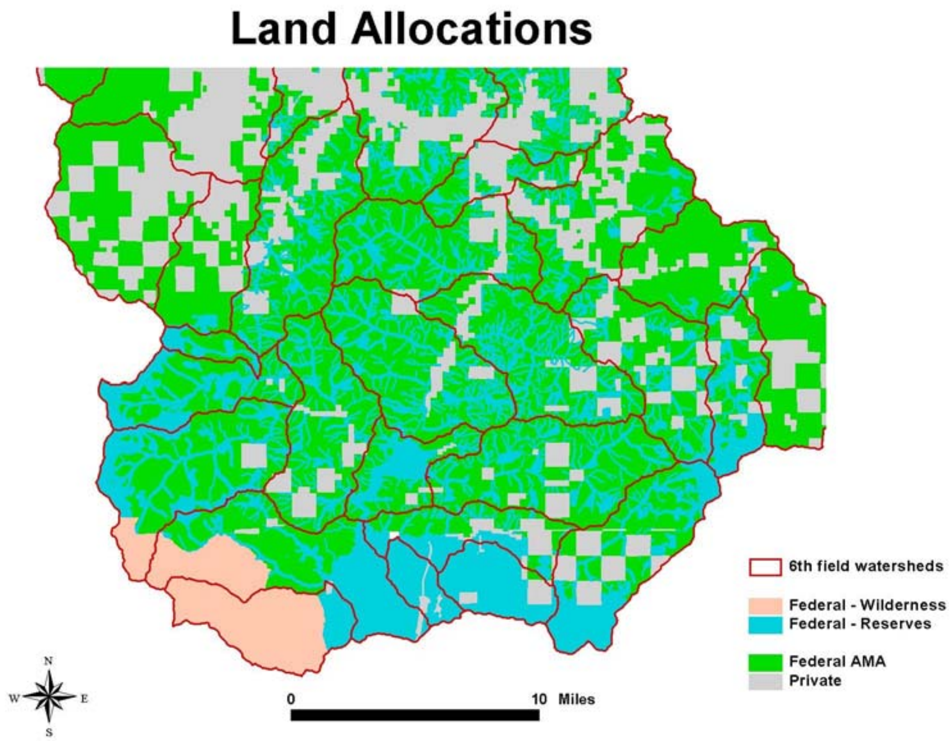


Figure 2: Federal land allocations within the planning area of this document, the Applegate watershed.

Habitat

Habitat distribution is a key component of this conservation strategy. Several projects that have assessed site and landscape-level characteristics of locations occupied by Siskiyou Mountains salamander were available to the team while this conservation plan was being developed (Ollivier et al. 2001; Reilly et al. Appendix 1; Suzuki and Olson Appendix 2; Welsh et al. 2007). The maps generated by Reilly et al. (Appendix 1) were used extensively during the selection of high-priority sites. The first iteration of the Reilly et al. model was derived from the results of an unpublished study of Siskiyou Mountains salamander habitats (Ollivier et al. 2001). An additional variable "illumination index" added aspect and topographic shading to the model. The Reilly et al. habitat model was used at site, 6th field watershed and landscape scales to assess the distribution of habitat during the development of this conservation strategy (Appendix 1, Figure A1.1). An underlying assumption of this conservation strategy is that areas that are not mapped as habitat by the Reilly et al. model may be occupied by salamanders. It was also assumed that areas not mapped as habitat by the Reilly et al. model will provide for some level of connectivity between high-priority sites.

Species Distribution

High-priority sites were selected from records entered into the ISMS database prior to August 2004 (Figure 1). These data included spring 2004 salamander locations resulting from mollusk survey efforts in the Star Gulch drainage on Medford BLM lands. It is important to note that the Team does not believe that this database contains all populations of Siskiyou Mountains salamanders nor do we believe that it represents an unbiased sample of all populations. However, the Strategy team was not limited by a lack of localities to select for high-priority management. Fieldwork conducted in 2003 located populations in gaps identified by the team as areas important to the long-term persistence of the species at one or more scales (Nauman and Olson 2004b). Species sites identified subsequent to this initial selection of high-priority sites have been used to fine-tune final high priority site selection in individual 6th-field watersheds, but are not documented here.

Fire Hazard

Fire is a natural disturbance across the landscape covered by this Conservation Strategy. Distribution of fire-prone areas on the landscape was estimated by mapping fire hazard models developed by local fire behavior experts from the Rogue and Siskiyou National Forest, Medford District Bureau of Land Management, and Oregon Department of Forestry (Figure 3). This map shows fire likelihoods that generally increase along ridgelines and south-facing aspects.

High intensity fires have the potential to adversely affect salamander micro- and macrohabitat conditions. Low intensity fires could adversely affect some habitat elements as well, but effects may be short term with long-term effects resulting in development of more resilient habitats.

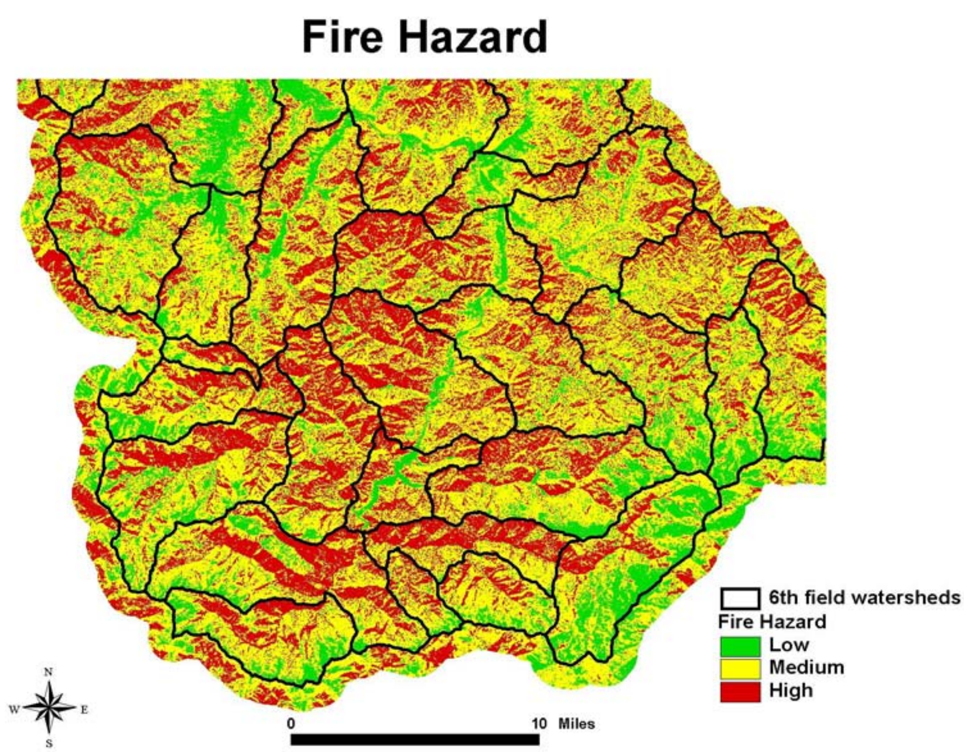


Figure 3: Fire hazard map for the Applegate watershed.

During the process for planning this salamander Conservation Strategy, fuel hazard mapping was reviewed to consider the potential risk of fire, and of high intensity fires, in a neighborhood around each site. The team considered: 1) selection of sites in lower fire risk areas, as possible; 2) selection of sites in a range of fire conditions, to represent the variety of conditions under which these animals occur; 3) selecting sites to allow for redundancy in an area with potentially higher fire risk; 4) site delineation of areas with a mix of fire hazards; and 5) management of selected sites to reduce risk of catastrophic high intensity fires. These elements were part of the site selection criteria, below, and fire was a component further modeled in the risk assessment procedure.

Risk Assessment

An integration of the above four conservation elements (land ownerships and federal allocations; modeled habitat; species distribution; fire hazard) was used to assess the risk to species persistence on the landscape.

At the beginning of the conservation planning process, such an assessment was done for watersheds with only the federal land ownerships and allocations used as land management standards and guidelines for salamanders. Land allocation, fire hazard, distribution, and habitat maps were overlaid per watershed, and panelists were asked to estimate the probability of persistence over a 100 year time span. Due to a variety of land management activities possible, and unknown longevity of current forest plans, there was a strong element of uncertainty voiced by panelists during these assessments. Uncertain trajectories of fire disturbances also weighed on panelists' minds, especially with recent knowledge of the Biscuit Fire (July 2002: 500,000 acres) and Timbered Rock Fire (July 2002: 27,000 acres) in southwestern Oregon. A worst case scenario of highly altered habitat conditions, relative to salamanders, was considered possible by most panelists. This led to variable and sometimes low likelihoods of persistence assessments within watersheds. As these watershed assessments were aggregated across the landscape, most of the range of the species occupied watersheds with a potentially low chance of persistence. This appeared to be partially a result of the large spatial extent of the AMA allocation in which >1 rotation of regeneration harvest activities were conceivable over a 100 year timeframe. This early result supported the notion that identification of salamander management areas and high-priority sites was needed, even within federal reserved land allocations, due to uncertainty in the future management and natural disturbance trajectories on federal lands. Subsequent panel assessments after the selection of high-priority sites began substantially raised assessments of likelihood of persistence per watershed, usually greater than about 80%. As these were aggregated across the landscape, an overall "high likelihood of persistence" rating resulted.

A more formalized process of assessing risk to persistence was developed and applied to the landscape (Suzuki and Olson, Appendix 2). This procedure resulted in a landscape risk map relative to this salamander species (Appendix 2, Figure A2.2). The map shows a mix of risk conditions across the landscape, with some patterns emerging with known habitat attributes, land allocations, and fire hazard. This map was used during site selection and 6th field watershed assessments to re-address aggregation of multiple factors and the potential consequences for salamanders. Similar to the list produced for fire hazard alone, above, relative to this risk map the team considered: 1) selection of sites in lower risk areas, as possible; 2) selection of sites in a range of risk conditions, to represent the variety of conditions under which these animals occur; 3) selecting sites to allow for redundancy in an area with potentially higher risk; 4) site delineation of areas with a mix of risk conditions; and 5) management of selected sites to reduce risk.

Species Hotspots

Distribution of species richness of rare and uncommon taxa included in the ISMS database was determined for the planning area of this Conservation Strategy. These data included known sites of fungi, bryophytes, lichens, vascular plants and mollusks. A map of these data (Figure 4) shows up to 5 taxa occurring within 1,000 m square grid cells overlaying the landscape. This map was considered during site selection in order to protect and overlap other species by designation of salamander high-priority sites.

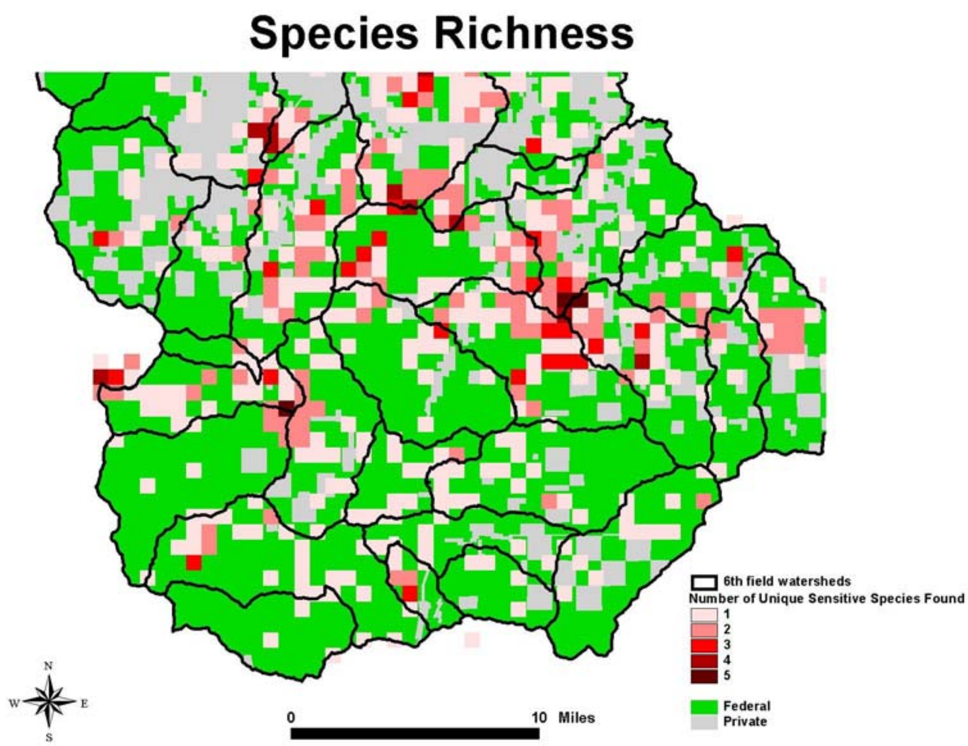


Figure 4: Map compiling known sites of rare and uncommon species to show “sensitive” species richness for the Applegate watershed.

Hierarchy of Scales

Three spatial scales are considered in this Strategy. Objectives are listed above corresponding to each scale.

Species Range: The range of the species in the planning area is the largest scale of consideration. At this scale, well-distributed populations are intended to be managed for long-term persistence, and sub-populations identified at the intermediate spatial scale are managed so that they may interact. This is the scale that geographic coverages of federal land allocations, habitat elements, fire hazard, and species localities were compiled. This scale was revisited throughout the site selection process to address concepts of connectivity among smaller scale units, and conflicting landscape priorities of species persistence, timber production, and fire suppression. The area of the species range for this northern population is approximately 100,000 ha (250,000 acres).

6th Field Watershed: The intermediate scale of the 6th field watershed was chosen to help develop a Conservation Strategy that could provide for well-distributed sub-populations of salamanders. Aggregation of well-distributed sites selected for management at the intermediate scale was intended to meet the range-wide objective. The 6th field watershed was chosen as an intermediate scale due to its size and current use in federal planning. While the Siskiyou Mountains salamanders may not occur on the landscape in a pattern corresponding to watersheds, watersheds are useful units to consider relative to some elements of salamander habitat or disturbance factors. For example, hill shading may change with aspect and ridgelines denoting watershed boundaries. Ridgelines may have higher fire hazard as well. The high-priority site selection process, described below, piggy-backed protections on existing federal reserves, which often occur within 6th field watersheds. Particularly, riparian reserve distributions follow a watershed pattern, and many of the salamander high-priority site management areas are delineated contiguous to riparian reserves or the spatial areas between two neighboring headwater tributaries. Also, the sizes of 6th field watersheds in this area were suitable to potentially harbor many salamander subpopulations. Within 6th field watersheds with multiple known salamander locations, the team was able to prioritize among locations to select high-priority sites for continued salamander management.

Thus, high-priority site selection occurred at this intermediate scale (see criteria below). Distribution of sites, habitats, federal lands, federal reserved lands, and other considerations weighed heavily into the high-priority site selection processes. As a watershed was analyzed, neighboring watershed conditions and proximity of sites across watershed boundaries were included as considerations for site selection. Similarly, a finer scale look at site conditions was conducted on a site-by-site basis. The intermediate scale is a focal point of the Conservation Strategy, but is a scale at which integration across scales was important and iteratively addressed. Nineteen 6th field watersheds were analyzed in the development of this Conservation Strategy. All of these watersheds have at least one known Siskiyou Mountains salamander location.

Sites: At the smallest spatial scale, salamander sites were prioritized for management/high-priority site selection. Per site, one of two outcomes was chosen: the site would be managed for site-level persistence of salamanders, or not. Only known sites of Siskiyou Mountains salamanders were considered for management; optimal habitat areas without known detections of animals were not considered for high-priority site selection. Every known site was considered separately as a potential location to identify as a high-priority site during the development of this Strategy. Known conditions and values of each site were listed. Expert knowledge of each site was discussed, aerial photographs displayed, and existing data on populations or communities examined. The spatial habitat model was used to estimate the geographic extent of optimal habitat elements near each site, while photographs or other geographic coverages were used to further estimate vegetation or single habitat element distributions or quality relative to salamanders. Some neighboring site locations in ISMS were merged for management consideration, especially as adjacent sites appeared to occupy contiguous habitat patches. Trade-offs of range-wide objectives to permit land management activities on the landscape for economic or ecological objectives, or to piggy-back protections on federal reserved lands, often were considered as site values were weighed. Over 300 sites within the watershed were considered in the development of this strategy. Nearly one-third were chosen as high-priority sites, to manage for continued salamander persistence.

Site Selection Process

High-priority sites were selected based on the need to maintain a well-distributed population across the landscape. The multiplicity principle of many protected areas rather than a few was used. Identifying high-priority sites in a wide range of areas based on elevational, geographical, and habitat condition (patch size, edge effects, etc.) gradients allows for maintenance of sub-populations throughout the range despite potential large-scale disturbances. Sites were selected on a watershed-by-watershed basis, using 6^{th} field watersheds as the intermediate scale planning area. This ensured that sites would be designated across the known range of the species in the planning area. Site selection was an iterative process. Site level assessments included examination of fire hazard maps, optimal habitat maps, topography, aspect, maps of known sites, distribution of Wildland-Urban Interface lands, land ownerships and allocations, and aerial photographs. Maps of species hotspots and risk also were evaluated on a site-by-site basis. Site value assessment may have been conducted for multiple sites at a time if locations occurred in clusters. The evaluation included zooming-out to watershed and larger spatial scales for pattern evaluation. Using this thought process, criteria or considerations were developed to identify high-priority site salamander management areas.

<u>Criteria or Considerations for High-priority Site (HPS) Selection</u>: Fourteen criteria (A-N, below) were developed for high-priority site selection. Some are conceptual or qualitative assessments while others rely on geographic positioning relative to available spatial coverages or other available data. Criteria are not mutually exclusive.

A. Total number sites per watershed - a site may have been chosen as a watershed representative because the entire watershed had very few known sites.
B. Redundancy - a site may have been chosen in or near a high (fire) risk area where one HPS may be lost, but others may persist.
C. Connectivity - locations where habitat or sites may connect to adjacent watersheds
D. Acres of habitat - large patches of contiguous habitat were emphasized in site choice
E. Proximity to large reserves were emphasized in site choice
F. Distribution of site in watershed in relation to other known sites (gap, cluster, edge, center)

G. Distribution of habitat in watershed – a site may have been chosen due to its position relative to habitat
H. Distribution of reserve in watershed – a site may have been chosen due to its position relative to federal reserve lands
I. Fire hazard - high-risk areas were displayed, and may have affected site choice for either redundance or likelihood of persistence
J. Communities at risk of fire (WUI = Wildland Urban Interface) – sites within and outside of WUI were considered for management, with acknowledgement of uncertain risk of WUI land management.
K. Central/peripheral within range - geographical gradient considered
L. Herptile community, high biodiversity – number of herpetofaunal species or Survey and Manage species detected at site, if known, was considered in site selection. Some "hotspots" were chosen.
M. Center of canyon, ridgetop - elevational gradient: a variety of slope positions were chosen.
N. High quality habitat – tree density and tree size: as available, higher quality habitats were chosen.

Additional considerations were discussed, but did not result in formal "criteria" for site selection. Age of the site record came up in a few cases when an odd location was assessed, perhaps in apparently unsuitable habitat. These sites may have been old records in areas that were subsequently managed to reduce forest overstory. Or, old records may have low precision in location due to historical field notes citing general directions to the sites or only township, range, and section locators. Whether or not salamanders were extant at sites with old records and apparently changed conditions was a concern. Also, some sites occurred in areas known to have high human use patterns. Sites near roads or recreation areas could be more prone to use patterns having adverse effects on salamanders.

During site by site evaluations, additional assessments were conducted. For sites selected as high-priority, the area identified as needed for management of the high-priority sites was determined from available maps and spatial coverages (see below). These areas were calculated, mapped, and land allocations evaluated. Also, per selected high-priority sites, management alternatives were considered, and the need for potential restoration was determined.

After sites were selected within a 6th field watershed, the pattern within the entire watershed was considered. Spatial coverages of habitat, fire hazard, and land allocation were reconsidered at the intermediate spatial scale with selected and non-selected sites. Potential interactions with selected sites in neighboring watersheds were considered.

After sites were selected as high-priority within every 6th field watershed, the pattern within the entire range in the planning area was considered. At this time, several topics were evaluated. Were sites selected at the edge of the species range? Were sites central to the species range selected? Were low and high elevation sites selected? Are sites in isolated habitat patches selected, as well as those in areas of more continuous optimal habitat at the range-wide scale? How well does optimal habitat appear to connect selected sites? Overlaying species richness data, are areas with high species richness represented in high-priority site salamander management areas? Overlaying the risk analyses, are a range of risk areas represented, including sites in low risk likelihood landscapes? What is the distance between selected sites? Might animals be able to move among sites in this dispersion pattern? In areas with apparent clusters of selected sites, is redundancy a selection criterion? Is the redundancy concept used near high risk areas?

Site Area Determination

The spatial extents of high-priority site salamander management areas were determined using multiple geographic coverages of site characteristics. Optimal habitat maps, known site distributions, watershed boundaries, topography, aspect, fire hazard, and land ownership/allocation maps were consulted. Aerial photographs also were used.

Habitat maps, reserve boundaries, and aerial photographs were the primary data used to delineate high-priority site boundaries for salamander management areas. Also, boundaries were adjusted with natural or anthropogenic breaks in site conditions, including roads, ridgelines, streams and aspect.

Although a range of sizes were considered, the size of a habitat patch needed to sustain a subpopulation of salamanders is not known. Density estimates are crude, at best, for this species. At a highly productive site, Nussbaum (1974) estimated densities of up to approximately 6,660 animals per hectare (i.e., 0.66 salamanders/m^2). 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/m^2, Ollivier et al. 2001). Due to the relatively high densities seen in this species, larger habitats may be more resilient to disturbances, and could have reduced edge effects. Larger areas may be particularly relevant to consider for isolated areas that may not have the potential for a "rescue effect" from adjacent salamander sites.

Site Selection Results

Of 316 known federal sites evaluated, 151 (48%) were included in 110 high-priority site salamander management areas for this Conservation Strategy (Figure 5, compare to all sites in Figure 1, page 11). Of the 110 selected sites, 44 are on BLM land and 66 are on Forest Service land.

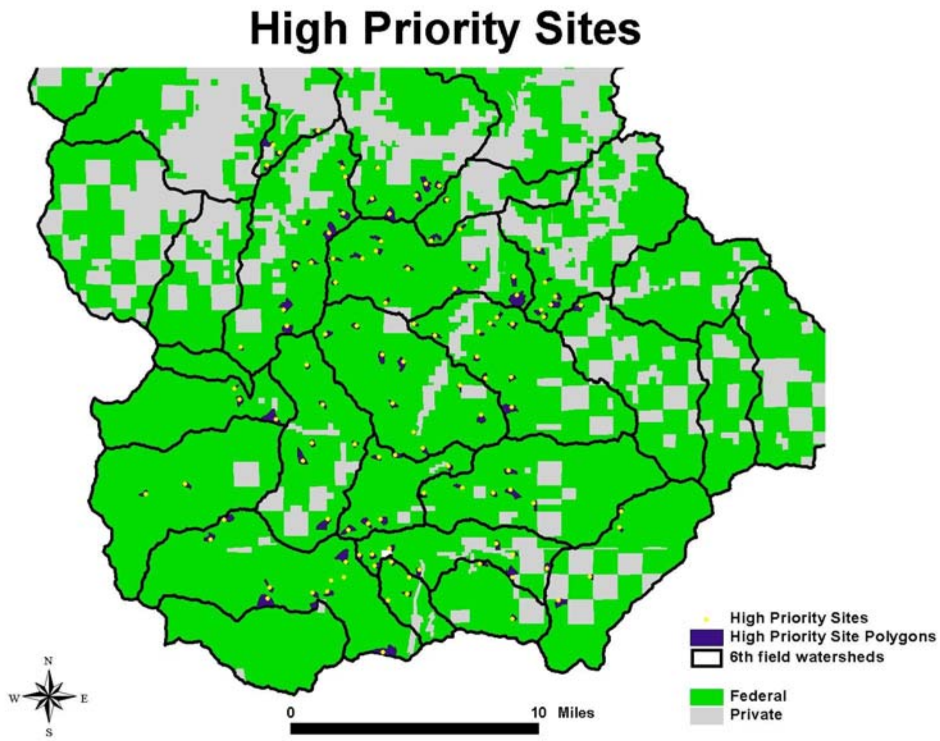


Figure 5. Sites and their corresponding habitat areas (polygons) selected for management in this Conservation Strategy.
Per watershed, 2-12 sites were selected; this was largely dependent upon the existing number of sites per watershed.

Criteria A-N, above, varied in the importance at each site and the frequency with which they occurred as a consideration for site selection (Appendix 3). For example, criteria F (site positioning relative to other sites; e.g., filling a gap in distribution) and N (habitat quality) were the most frequently cited considerations for site selection; over 60 selected sites were chosen for reasons that included F and/or N. Criteria A, E, and H had moderate usage: number of sites in a watershed, large reserves, and proximity to reserves. In contrast, the least used criteria included B, C, D, G, I, J, K, L, and M, each of which were cited for less than 20 selected sites. However all criteria were considered at each site selected, some criteria were consistently deemed to be of higher importance at determining sites.

In watersheds with few sites, all or most were selected as high-priority site salamander management areas. For example, in Slagle Watershed, 4 sites were known and all were selected as high-priority sites for species persistence/conservation. In contrast, watersheds with numerous known sites had only a portion of them selected for continued management. For example, Thompson Creek watershed has 28 sites, of which 15 were selected as high-priority sites. Watersheds with potential habitat but with no known sites (e.g., due to a lack of surveys) were afforded no salamander protection at this time (e.g., O'Brien Creek watershed). Future sites identified in watersheds such as these could be added into the conservation strategy if warranted.

Distances between sites selected as high-priority averaged about a half mile. Although this distance did not result from a scientific understanding of dispersal distances or salamander life history, there was consensus among the panelists that salamander connectivity might be achieved by this pattern. In many cases, habitat features in the intervening areas are likely to functionally connect sites facilitating gene flow among the high-priority sites/managed subpopulations. Spatial layers of individual habitat elements such as rocky substrates, canopy closure, large trees, and limited solar exposure often show contiguous patches over large areas. The combined model of all four features also shows continuity of "optimal habitat" conditions between many sites. For example, Middle Fork Applegate and Joe Creek watersheds have large contiguous blocks of good habitat that might serve as source areas for salamanders. Much of this area is within federal reserve allocations, and thus redundancy and lower risk to salamanders might also be achieved. However, upon inspection of this area the team noted a gap in distribution, and thus selected an additional site. The team also noted there were some potential topographic barriers between sites, perhaps reducing the potential for habitat contiguity. Selected sites spaced one-quarter to one-third mile apart were re-assessed. The team considered whether this closer spacing reflected a choice for redundancy, or occurred incidentally during site selection. In a couple of cases, the team de-selected or moved the selected site to increase spacing. The team also looked at areas with spacing greater than one-half mile, and examined known site data to see if localities were available to decrease such spacing.

Management Area Objectives

Each high-priority site salamander management area is intended to maintain a subpopulation of Siskiyou Mountains salamanders over the long term. The aggregate of high-priority site salamander management areas within the entire landscape covered by the conservation strategy is intended to maintain well-distributed populations of this species and prevent a trend towards listing.

Connectivity among many high-priority site salamander management areas, to maintain interacting individuals across the landscape, is assumed to occur via the occupancy of animals in intervening areas that are not managed specifically for salamanders but are likely to continue to have optimal habitat conditions (e.g., Appendix 1, Figure A1.1), or subsets of suitable habitat conditions provided by rocky substrate, canopy, large diameter conifer trees, or dark illumination.

Spatial Extent of Management Area

Per high-priority site, areas for salamander management ranged from 8 to 181 acres (Appendix 3), averaging 43.5 acres. Overall, 4,774 acres were identified for salamander management, 1,950 acres on BLM lands and 2,824 acres on Forest Service lands. Of these, 2,313 acres (48.4%) are in existing federal reserve land allocations (Forest Service LSR - 310 acres; Owl Cores – 676 acres [BLM – 340 ac, Forest Service – 336 ac]; Interim Riparian Reserves – 1,087 acres [BLM – 436 ac, Forest Service – 651 ac]; Forest Service no harvest allocation – 240 acres), and the remaining 2,461 acres (51.5%) are in the AMA/Matrix allocation (BLM – 1,174 ac; Forest Service – 2,824 ac.). About 40% of these salamander management areas occur within the Wildland-Urban Interface boundary. Restoration management actions are described below for these areas.

Habitat Management Strategies

It is expected that management activities may need to occur within the high-priority site salamander management areas to provide for the long-term persistence of the species in these locations. Current fuel loadings create an increased risk of crown fires that may affect habitats and animals at sites. Two management strategies were developed in order to protect the sites from fire, but still maintain the microclimatic conditions of the site.

Management Strategy 1: This is a conservative approach, appropriate for sites with apparently suitable quality habitat conditions for this organism, without high risk of fire due to fuels loading. Under this approach, no canopy reduction or heavy equipment use is recommended within the high-priority site salamander management area. Non-commercial thinning adjacent to sites in order to reduce fire risk is recommended, however. Ground brush and ladder fuels (trees less than 8" dbh, brush, lower limbs) should be removed using hand tools (e.g., chainsaws). Piling and burning should occur outside of rock substrate, if possible. Sites managed under Strategy 1 are hoped to act as refugia for this species as well many other species likely to be found in this habitat type.

Management Strategy 2: This is an active forest management approach recommended for sites with high fuel loading outside of desired conditions that could lead to high intensity fire (these sites were identified during site evaluations), areas where restoration is needed to improve salamander habitat, and for sites managed for fuels reduction in the Wildland Urban Interface. This strategy was developed to allow forest management priorities at the landscape scale to proceed, while hopefully improving habitats for salamanders. This strategy has some risk to salamanders because the effects of the recommended forest management activities have not been assessed. Appendix 4 outlines these "Fire Management Recommendations".

General Conservation Guidance: For both management strategies 1 and 2, maintenance of substrate and vegetation integrity at *P. stormi* 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 the microhabitat conditions required for the species are not affected. Cool, moist microclimate conditions are thought to be needed for this species; these attributes should be considered during any proposed activity so that these conditions are not compromised. In particular, retention of canopy closure is likely important in the maintenance of sub-surface microclimates needed by this animal.

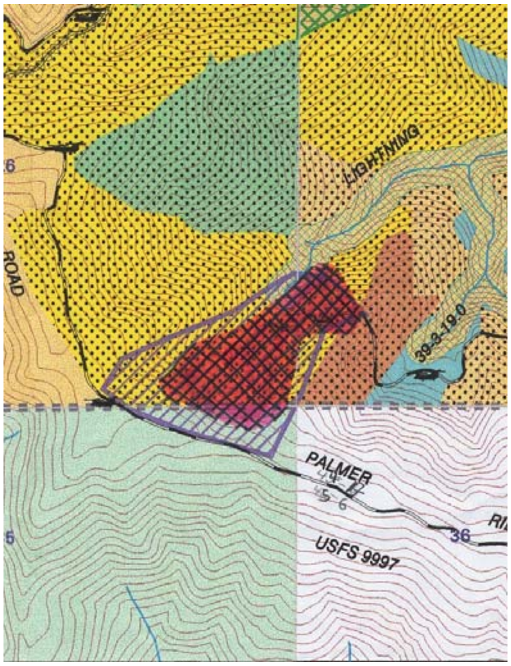
Any proposed activities within high-priority site salamander management areas should be assessed to identify the potential hazards specific to the site. The hazards and exposure to salamanders of some activities relative to ground disturbance, microclimate shifts, and incidental mortality may be minimal. 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. Restoration activities should be assessed, in addition to other disturbances. Thus, both current and predicted future site conditions of the site and its habitat should be considered during risk assessment procedures. If the risk, hazards, or exposure to actions are unknown or cannot be assessed, conservative measures are recommended.

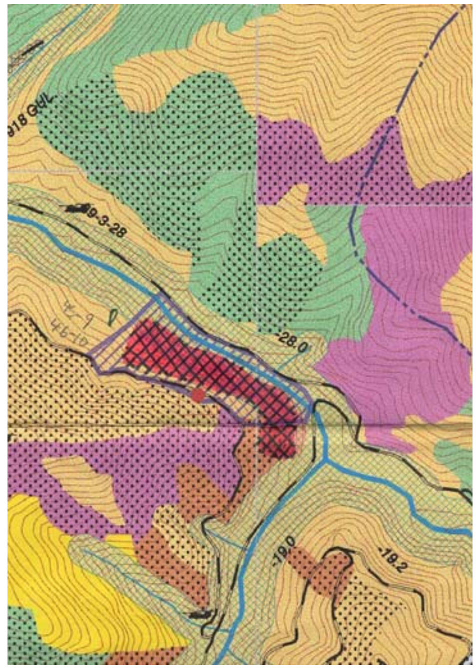
Land-use practices proposed for areas within Siskiyou Mountains salamander sites should take the seasonal activity patterns of this species into consideration. Disturbance of animals and their habitats during wet periods (fall/spring), when animals have increased surface activities could result in direct mortality to individuals. Within these high-priority sites, a seasonal restriction for any ground disturbing activity should be considered from October 1 to May 30 to reduce direct mortality of animals. However, it may be possible to conduct activities during the winter as these animals retreat to below-surface refuges during freezing conditions. If conditions remain dry in the fall or cold in the winter, surveys could be considered to determine whether or not the animals are active at the surface, if they are not, activities could continue.

Management Flexibility

Management discretion of high-priority salamander sites is expected. Although specific sites have been selected and delineated as high-priority salamander management areas, there is considerable flexibility to fine tune these recommendations during project planning. As projects are proposed within watersheds, there is an opportunity to field validate assumptions used for site selection. Ground-truthing of habitat conditions within selected salamander sites is needed, and boundary delineation should be revisited. An example of site ground-truthing has recently occurred by Medford BLM. Figures 6 and 7 show two sites selected in this strategy as high-priority site salamander management areas. Field validation of site conditions largely supported the remote assessment that was used in this Strategy, which used GIS coverages and aerial photographs. Fine-tuning of site boundaries occurred, however (Figures 6 and 7).

New knowledge should be reviewed periodically by the Rogue River-Siskiyou National Forest, Siskiyou Mountains District and Medford BLM Ashland Resource Area field unit representatives (biologists, planners, other resource specialists and managers), especially new known sites of salamanders or changes in habitat conditions. Re-selection and re-delineation of high-priority site salamander management areas is possible by the field unit representatives if sufficient information on any new proposed priority sites is available. The same selection criteria as was used for original site selection should be used to determine if new sites are suitable as high priority sites.





Figures 6 and 7: Maps showing two sites selected for management with the initial habitat areas delineated by this Conservation Strategy for site management using GIS data (purple cross hatch) and final area delineated by field crews after site reconnaissance to validate habitat quality and site conditions (red hatching).

Inventory, Monitoring, and Research

Surveys to compile new information and assess effectiveness of management approaches are an important part of this Conservation Strategy for the northern population of the Siskiyou Mountains salamander. Inventories for species distribution are particularly relevant in areas with little knowledge of salamander occupancy. Also, as projects are planned, field reconnaissance of habitat conditions and surveys for species occupancy will help to fine-tune finalization of any high priority site within the project area in a given 6th field watershed. Monitoring is needed relative to the implementation and effectiveness of the two management strategies outlined, and to examine the assumption that areas between high priority sites are occupied by the salamander and may serve as habitat for connectivity across the larger landscape. In addition, we recommend studies to fill critical information gaps be implemented because these may have important implications for the adaptive management of the Strategy.

Inventory

Survey or inventory approaches may vary. A standardized survey protocol has been developed to assess *P. stormi* presence prior to habitat disturbing activities associated with land management (Clayton et al. 1999, available at: http://www.blm.gov/or/plans/surveyandmanage/SP/Amphibians99/protoch.pdf). The protocol outlines survey procedures and environmental conditions that optimize detection probabilities. This protocol is recommended to be used if surveys were to be conducted as potential projects are planned and refinement of high priority site selection is conducted.

Surveys to increase knowledge of the species occupancy in current gaps in distribution can effectively advance the adaptive management of this Strategy. Survey approaches for this purpose may follow the established protocol, but also may include opportunistic searches with non-standard procedures, or purposive searches of selected areas. Purposive surveys in optimal habitats in gaps previously yielded about a 60% success rate in detecting salamanders, and greatly expanded our knowledge of species distribution in the Applegate watershed (Nauman and Olson 2004b). Sixth field watersheds that would be high priority for surveys to increase occupancy and distribution knowledge include O'Brian Creek, Sturgis Fork, Steve's Fork, Slagle Creek, and Yale Creek

In addition, studies addressing species-habitat associations, habitat model validation, or occupancy patterns in areas not designated as high priority sites may have 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. The current survey protocol (Clayton et al. 1999) relies on a streamlined approach of timed surveys for occupancy, with multiple site visits under restricted environmental conditions. Mark-recapture methods may be effective approaches for long-term site or population studies (Heyer et al.1994), and can help to address species detectability issues. The success of artificial cover boards to survey for terrestrial salamanders has been limited in xeric forest habitats of southern Oregon (K. McDade, unpublished data), such as those occupied by *P. stormi*. Nocturnal surveys may be effective, but may be hazardous to surveyors in remote areas.

If surveys are conducted, documentation is essential. As possible, survey locations should be located with Geographic Positioning Systems (latitude and longitude: Universal Transverse Mercator [UTM] grid coordinates), and data forms should be used to consistently capture survey methods and results including ambient temperature and relative humidity. Electronic data entry into a database is crucial for rare species management and status assessments. Locality data for *P. stormi* on federal lands resides in GeoBOB for the BLM, or NRIS for the Forest Service, databases. Annual electronic entry of new survey data, both from surveys of species-detections and surveys with no species-detections, should be conducted. These well-maintained databases can contribute to species management decisions, as locations of managed sites can be analyzed to address species rarity questions and species persistence objectives.

Monitoring

A 5-year monitoring plan will address implementation and effectiveness of the Strategy. This plan will be developed by the Rogue River-Siskiyou National Forest, Siskiyou Mountains District and Medford BLM Ashland Resource Area field unit representatives (biologists, planners, other resource specialists and managers), and will include an implementation and effectiveness monitoring plan to be completed within the first year of acceptance of the conservation plan. Costs for initial development should be approximately $6,000.00.

In year two through five, effectiveness monitoring of the activities management proposed in the conservation plan would occur by the field units. Questions would include, have the proposed management strategies occurred within sites, has there been discretion to field validate and delineate sites as needed, are there animals present post-activity at the site? Distributional surveys in priority areas and in potential connectivity areas could also occur at this time. Costs for this should be approximately $5,000.00 or less

As impacts to sites occur, annual accomplishment reporting should be conducted, and electronic data entry in BLM GeoBOB/FS NRIS provides a standard format for documentation. All applicable GeoBOB/NRIS data fields should be completed (e.g., site management status, non-standard conservation action; threat type; and threat description). With later monitoring for effectiveness of management approaches, surveys can assess impacts to habitats or species and results can be recorded into GeoBOB/NRIS or other local or regional sensitive species databases in order to facilitate persistence assessments.

Resurveys of past-populations are also needed, in addition to both implementation and effectiveness monitoring of past management actions. 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 continue to threaten this species at the same level as previously perceived? What protective measures have been implemented, and what were the results of this management?

Data Gaps and Information Needs

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:

- Some gaps in known site distribution within the known range in the Applegate Valley

- The potential effects of fuels treatments within suitable habitat and high priority sites.

- Microclimate conditions required by the species in surface and subsurface refugia, such as ambient and soil temperature and relative humidity, minimum canopy closures needed, 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 behavior and timing, distances for movement, dispersal, and foraging.

- Geographic boundaries of discrete populations, connectivity among populations, and connectivity among selected high priority sites.

- Effects of multiple hazards or risks to species across landscapes and populations.

- Species' role in communities and ecosystem processes

Research

The data gaps discussed above each relate to needed research on this animal. The microclimate requirements of these animals are of particular concern. 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.

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.

Adaptive Management

A regular review of this conservation strategy will be conducted every five years by the field units. A large portion 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 our assumptions as to the habitat requirements, and effects of land management activities on the species. A primary area of interest is whether or not fuels management and current timber management practices impact this species. Information on these issues will be particularly relevant to compile and evaluate during the 5-year reviews.

Additional activities or changes that should trigger an immediate review include;

- A significant change in the number of known sites within a sixth field watershed so that the understanding of the distribution of the species has changed to the extent that sites may be added or re-prioritized.

- A significant range change or extension has occurred such as a site found north of the Applegate River or in another 6^{th} field watershed not previously known to harbor the species. .

- Significant changes in Forest Service or BLM Land-Use Allocations as determined by the field unit, within the area of the conservation strategy or a significant management direction change on Federal lands within the area of the conservation strategy.

- A significant change in habitat conditions due to large-scale fire that may change our assumptions as to the persistence of high-priority sites identified within the conservation strategy. This might occur when more than half of one 6^{th} field watershed occupied by the species is affected by the disturbance.

- New science that significantly alters our understanding of the ecology of this species or its habitats.

V. ACKNOWLEDGMENTS

We are 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 and USFS/BLM Sensitive Species Programs over the last ten years.

VI. 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. (USDA, USDI 1994a)

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.

Oregon Heritage Ranking

List 1 contains taxa that are threatened with extinction or presumed to be extinct throughout their entire range. These are the taxa most at risk, and should be the highest priority for conservation action.

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Appendix 1

Spatial Model of Optimal Habitat for the Siskiyou Mountains Salamanders north of the Siskiyou Crest

Ed Reilly, David Clayton, Richard Nauman, Deanna Olson, Hart Welsh, Brenda Devlin

A landscape level habitat prediction model was developed utilizing existing geographic (i.e., GIS) data layers to display the location and extent of the features known to be associated with occupied salamander sites. This model was developed for the entire range of the northern population of the Siskiyou Mountains salamander, *Plethodon stormi*.

Previous researchers and naturalists (e.g., R.M. Storm, R.A. Nussbaum, D. Clayton, R.B. Bury, others; see Habitat, above) have offered evidence that a prerequisite for salamander habitat is rocky cobble or talus soils with cool, moist conditions. In 2001, Ollivier et al. published the results of a field level analysis undertaken to determine stand level habitat associations for Siskiyou Mountains salamander. Their study design included a stratified systematic approach with random site selection. Two strata used were forested stands (pre-canopy to old seral stages) with rocky substrates. This design allowed inference to the sampled landscape which includes the area of this conservation strategy. We examined their results to determine whether or not there were correlates with salamander presence that could be modeled across the landscape using available GIS coverages. We found three variables from the Ollivier et al. (2001) research having apparently strong association with salamander presence that could serve in such a model. These included rocky soil types with adequate interstitial spaces, forest canopy closures above 70% and conifer forest types with average tree size above 17 inch DBH (Diameter Breast Height). A fourth variable was derived during the course of our investigations, illumination index. These associations and the spatial coverages used relative to each are described further below.

Rocky substrates were included as a baseline stratum defining “minimum essential habitat” for Siskiyou Mountain salamanders in the Ollivier et al. (2001) study. For our spatial habitat model, digital soil survey maps from Jackson and Josephine Counties, Oregon (1999), along with U.S. Forest Service Level 2 Soil Resource Inventory (SRI) mapping (1983) were used to determine the locations of suitable rocky talus and cobble soil types. Generally rock types with known locations of the salamander as well as rock types with 50 percent or more of gravel or cobble content were used in the model.

Ollivier et al. (2001) reported canopy closure and larger conifer tree diameters were associated with salamander presence. In Oregon, they found that the most occupied sites had minimum canopy closures > 60%, and that the average minimum canopy closure at occupied sites was 78%, with a 95 % confidence interval ranging from 71 to 84%. Average canopy closures at most occupied sites were >70%. We used 70% canopy closure in our modeling effort of optimal salamander habitat. Larger conifer trees also were included in Oregon models explaining salamander presence produced by Ollivier et al. “Large trees” were defined as those with diameters 53 cm and larger (20.8 inches). They also found a negative relationship with small conifer basal area and a positive relationship with an understory of hardwoods. We further analyzed their conifer tree data to examine the descriptive statistics of conifer tree sizes and other stand components at occupied sites. We found the mean diameter at breast height (DBH) for all conifers at occupied sites was 17 inches. At Ollivier et al. sites without salamander detections, trees were an average of 13 inches DBH. Similarly, the mean DBH for Douglas-fir trees (*Pseudotsuga menziesii*) was 17 inches at occupied sites. Over 90% of the detections occurred within stands with tree sizes of 15.7 inches and greater. Re-examining the stand ages at occupied sites, we found that <25% of stands with salamanders were <80 years old, in comparison to 42% of stands without salamanders being <80 years old. We considered this discrepancy a reflection of likely historical stand conditions in the area, and conditions to which these salamanders have likely existed (i.e., salamanders occurring in older stands, and hence in areas with larger tree sizes). Larger trees and older stands also may reflect more stable habitats through time, to which salamanders may consequently have more established populations. In this conceptual model, we felt larger conifer DBH was an indicator of both good habitat quality and stability, potentially resulting in local subpopulations with higher likelihoods of persistence. Thus, in order to develop a model of high quality or optimal habitat conditions for this animal, we used the mean DBH rather than a standard error or deviation measure; we used conifer diameters > 17 inches.

For our spatial model, canopy closure and average stand level tree size were derived from a 1995 remote sensing vegetation classification map. This map was created from Landsat 7 satellite imagery processed by Geographic Resource Solutions of Arcata, California, and was funded and administered as a cooperative project between U.S. Forest Service and Bureau of Land Management.

Ollivier et al. (2001) results include attributes associated with ground microclimate. Cool and moist conditions are known to be associated with surface activity of these animals, and is suspected to be associated with occupancy patterns. They found associations between canopy closure and stand microclimate, and surmised that forest canopy served to retain surface conditions suitable for these salamanders. Similarly, large trees may be a surrogate for some microclimate elements. Aspect was an attribute included in the Ollivier et al. model for Oregon sites, with salamander presence associated with north-facing slopes. We considered using aspect in our spatial modeling effort, but felt that a better indicator of microclimate also would include an integration of topography and sun position. We investigated the “illumination index” available in GIS. Illumination describes the amount and extent of solar radiation reaching the earth’s surface at any given point. Illumination differs from aspect in that aspect only describes which direction a slope or earth mass is facing. Illumination takes into account the land masses that may block the sun and cast shadow. Various alignments of mountains and valleys can cast deep shadow into ravines and canyons thus supplying the needed shade conditions that allow an area to remain moister throughout the summer months. For our model, solar illumination was derived from a 10-meter resolution USGS Digital Elevation Model. The latitude and longitude of a location within the range of *P. stormi* was used to compute a position for the sun and noon on June 21, the time of the year when the sun would be at its maximum height. Using the ESRI Arcview hillshade command, an illumination model was created and used as part of the matrix for the potential habitat model. We found an association between dark illumination and occupied salamander points, using the Ollivier et al. data. Subsequent analyses have supported this association between salamander presence and the "dark side" (Welsh et al., 2007; Suzuki and Olson, Appendix 2).

The four factors outlined above were combined and mapped to show areas with rocky substrate, forest stands with average tree size of 17 inches DBH or greater and 70% canopy or greater. In addition, the solar illumination was added to display areas with high proportion of shade in the summer. The resulting map (Figure A1.1) of potential salamander habitat was used for delineation of high quality habitat to be used for conservation planning and the establishment of salamander management sites.

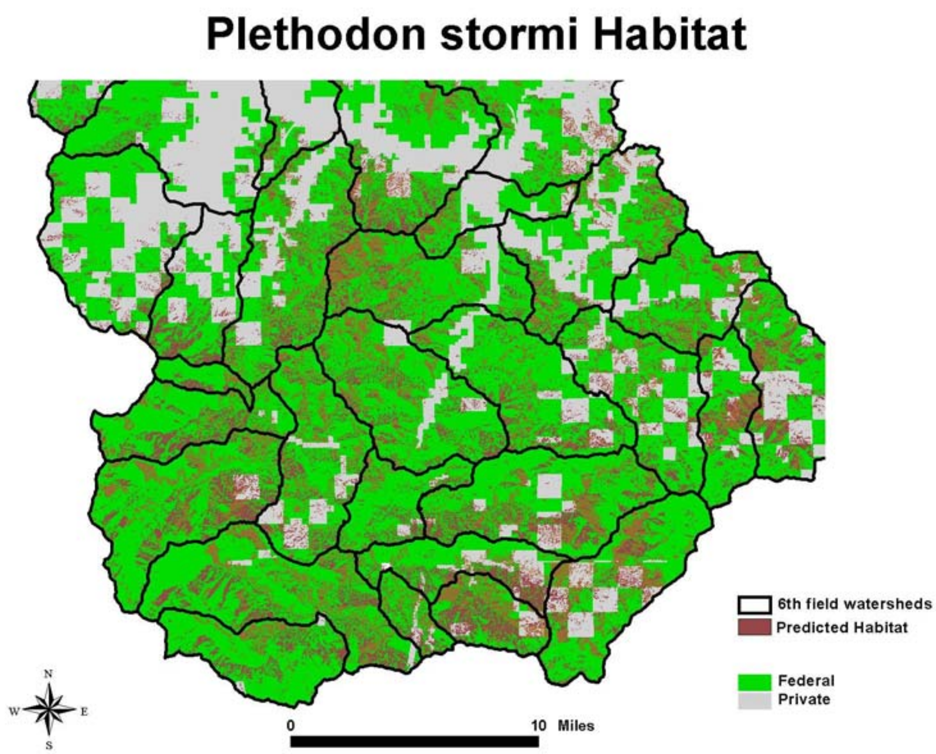

Figure A1.1: Map of the optimal habitat areas (brown) predicted from this spatial model.

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Appendix 2

Assessment of Risk to Conservation of Siskiyou Mountains Salamanders in the Applegate Watershed

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Deanna (Dede) Olson, USDA Forest Service, Pacific Northwest Research Station.

Due to a lack of sufficient biological and ecological information, it is often difficult for conservation biologists and planners to conduct a population viability analysis or to develop an effective conservation plan for rare species. The Siskiyou Mountains salamander (*Plethodon stormi*) is a rare endemic species only found in the Siskiyou Mountains in southwestern Oregon and northwestern California. It is a U.S.D.A. Forest Service Sensitive Species in Region 6 and Region 5; a U.S.D.I. Bureau of Land Management, Sensitive Species in Oregon; and it was formally classified as a survey and manage species under the U.S. federal Northwest Forest Plan and currently is petitioned for protection under the federal Endangered Species Act.

Habitat associations for Siskiyou Mountains salamanders were quantified using field data on habitat attributes measured at systematically located survey points (Ollivier et al. 2001). Because detailed habitat characteristics cannot be readily inventoried in the field for a broad landscape, application of habitat models developed from field data are inherently limited in geographical scope. In contrast, some habitat attributes, such as dominant vegetation types and many abiotic characteristics, can be efficiently estimated over an entire landscape using remote sensing or other related techniques without an intensive field sampling. Such inventory information across the landscape has become increasingly available on Geographic Information Systems (GIS) databases in recent years for many geographic regions.

Along with habitat information, GIS databases typically include spatial distributions of factors that may impose risk to persistence of species across the landscape. Some of the potential risk factors for late-seral associated species may include land allocation and ownership pattern, road density, fuel accumulation in fire prone areas, and management activities considered for the wildland-urban interface. In the present study, we propose that information from GIS databases can be used to assess vertebrate-habitat relationships and to develop habitat suitability models that are applicable at broad spatial scales for Siskiyou Mountains salamanders. Furthermore, we evaluate relative likelihood of persistence for Siskiyou Mountains salamanders across the landscape by quantifying the distributional relationship among habitat suitability, known species distributions, and potential risk factors.

Our objectives were: 1) to develop a GIS based habitat suitability model for the northern population of Siskiyou Mountains salamanders in the Applegate watershed of Oregon; and 2) to develop a landscape map to assess risks to persistence of Siskiyou Mountains salamanders in the Applegate watershed.

Methods

Habitat Suitability Model

We tested association of Siskiyou Mountain Salamanders with the following habitat variables available from GIS layers: June solar illumination, distribution of rocky soils, distribution of Douglas-fir, distribution of Oregon white oak, and distribution of white fir. The original GIS layers of solar illumination, distribution of rocky soils, and vegetation classification were described in Reilly et al. (Appendix 1). For distribution of tree species and rocky soils, we counted number of original pixels (25 m x 25 m) where each tree species was recorded as dominant or soil type was classified as having rocky substrate; the pixels were counted for every 100-acre grid cell across the range of the northern population of Siskiyou Mountains salamanders in the Applegate watershed. Similarly, June solar illumination was calculated for every 100-acre grid cell by averaging solar index values of original pixels (10 m x 10 m). We used 39 spatial coordinates with positive detection of Siskiyou Mountains salamanders identified by Ollivier et al. (2001) and also generated 39 random spatial coordinates for this study. Values for the 5 habitat variables from 100-acre grid cells were compared between 39 spatial coordinates with salamander detections and 39 random spatial coordinates using logistic regression analysis (SAS Institute Inc. 1995). The logistic regression model was used as a habitat suitability model to evaluate relative probability of species occurrence across the landscape and also included in the subsequent assessment of conservation risk. Because the random coordinates were selected retrospectively, the logistic regression model does not produce estimates of prospective probability of occurrence; however, the estimates of coefficients for explanatory variables from retrospective study are same as those from prospective study (Ramsey and Schafer 1997:596). Therefore, the model was sufficient to produce relative estimates of probability for species occurrence across the landscape. Based on the logistic regression model, we calculated relative probability of salamander occurrence for all the 100-acre grid cells and produced a spatial map of habitat suitability for the northern population of Siskiyou Mountains salamanders. The corresponding GIS coverage of habitat suitability was used in the subsequent assessment of conservation risk.

Assessment of Conservation Risk

A risk map assesses relative risk to persistence of a species or its habitat across a given landscape. We defined risk as a relative measure for likelihood of persistence of a species or its habitat on a given landscape. To quantify risk (relative measure for likelihood of species persistence), we divided the project area into 2712 100-acre (40ha) grid cells and quantified 4 factors of risk and 2 factors of species persistence within each grid cell using GIS layers of these 6 factors. Four factors of potential risk included land-allocation type, road density, relative potential for stand replacement fire, and Wildland-Urban Interface (WUI) boundary. These four factors potentially reflect gradients of disturbance with adverse effects to habitats occupied by Siskiyou Mountains salamanders. Assumptions of risk were subjective assessments due to a lack of data on impacts of these possible factors on salamander survival or reproduction. Two factors of species persistence included known species occurrence and habitat suitability. For these 2 factors, we assumed likelihood of persistence increased with known occupancy and occurrence of habitats highly associated with species detections. In quantifying risk scores for 100 acre-grid cells on GIS layers, each of 6 factors (4 risk and 2 persistent factors) was measured in such a way that higher score indicated higher relative risk to persistence. For example, the reciprocal of habitat suitability was used so that areas with potentially poor habitat suitability would generate higher scores, indicating high risk to persistence (or low relative likelihood of persistence) in such areas. Risk associated with land-allocation type was based on the proximity and size of reserves and intensities of management activities allowed by current regulations on different land allocations. According to these criteria, the lowest risk rank of 1 to the highest risk rank of 4 was assigned to the following land allocation types: wilderness areas and late-successional reserves = 1, riparian reserves and spotted owl reserve = 2, federal AMA/matrix lands = 3, and private lands = 4. For a 100 acre grid, we determined risk score of land allocation by first multiplying area of each land type by corresponding risk rank and then by adding these numbers among all land types. Risk scores of WUI were based on areas of WUI boundaries in grid cells assuming potential increases in risk with increasing areas of WUI boundaries. To determine relative potential for stand-replacement fire, number of original pixels (25m x 25 mc) with high fire risk was counted for 500-acre area around every pixel on the original GIS layer; these numbers were then averaged for each 100 acre grid cell across the project area. We assumed risk to persistence of salamanders would increase with increasing potential for stand-replacement fire. Road density was also quantified within each 100 acre grid cell assuming that the risk would increase with increasing road densities. After quantifying all 6 factors across the landscape, we standardized the risk scores for each factor to the unit of standard deviation so that 6 factors were comparable to each other in the same unit. For a given factor, standardized score indicated deviation of each score from the average of all scores in number of standard deviations. The sum of standardized scores from all 6 factors was calculated for each grid cell to produce a total risk score of a grid cell. Summed scores were used as a simplistic approach because relative importance of various risk and persistence factors is unknown. A more sophisticated model could weight these factors. All 100-acre grid cells were ranked from the lowest to highest risk based on the total summed risk scores, and percentiles were assigned. The percentiles of risk scores represent the measure of relative likelihood of persistence and were projected on z-axis in 3 dimensional maps of relative risk to persistence of Siskiyou Mountains Salamanders in the Applegate Watershed.

Results and Management Implications

The occurrence of Siskiyou Mountains salamanders was positively associated ($P < 0.05$) with the distribution of rocky soils and negatively associated with the distributions of Oregon white oak and white fir trees and June solar illumination. Occurrences were also positively associated with the distribution of Douglas-fir trees when Oregon white oak and white fir were not in the model. The logistic regression equation with these habitat parameters correctly classified 84% of occupied sites as occupied sites and 72% of random sites as random sites with overall classification level of 78%. Based on the final logistic regression model, probabilities of detection were calculated across the landscape and used as a measure of habitat suitability for the Applegate watershed (Figure A2.1). The model was also visually examined its validity by overlaying all the currently known sites of Siskiyou Mountain salamanders on the habitat suitability map.

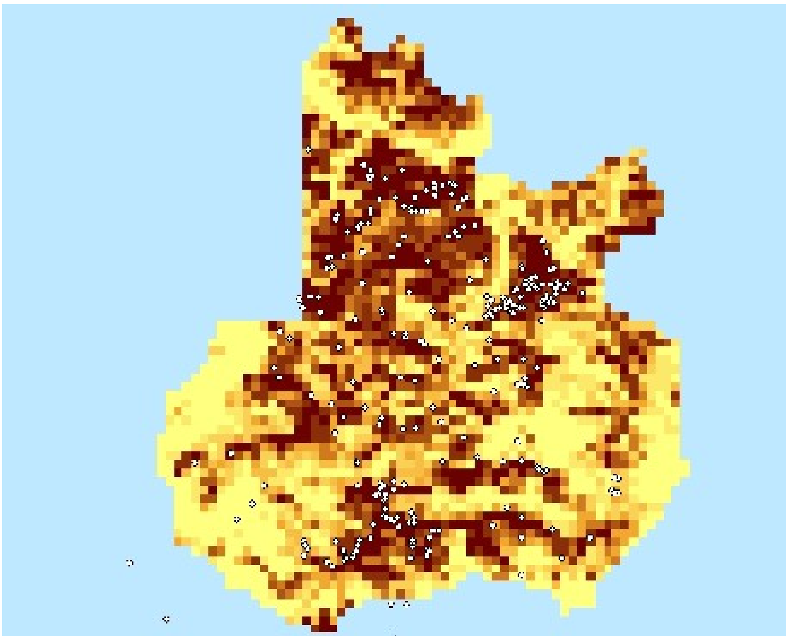

Figure A2.1. Map of habitat suitability for Siskiyou Mountains salamanders based on detection probabilities predicted by the logistic regression model. Darker colors represent higher probabilities of detection. Overlay of currently known salamander sites indicates good correspondence between the model predictions of suitable habitat and the actual occurrence of salamanders.

The risk map identified areas in the Applegate watershed that are potentially low risk to the persistence of Siskiyou Mountains salamanders (Figures A2.2 and A2.3). This map does not represent elevation, but rather, the z-axis reflects risk. However, due to a correspondence of risk and persistence factors to some geographic parameters, such as aspect, a topographic signature can be detected. Figure A2.3 (see "b" on map) shows an area of the landscape with a north-facing slope (i.e. dark illumination) with rocky substrates and lower fire hazard. Some land ownership signatures also emerge on the map (Figure A2.3, see "c" on map). The overall pattern shows a mosaic of risk to salamander persistence. Natural land anthropogenic factors are included and a patchy survivorship trajectory at the landscape scale can be envisioned.

In developing the conservation strategy for this species, the map was used to assess gaps and validity of high priority conservation sites determined by the conservation planning team. The revisions of high priority sites determined by conservation experts were generally in agreement with the distribution of low risk areas in the map; however, some high priority sites were strategically located in high risk areas to maintain the well balanced distribution of high priority sites across the landscape. Based on our trial application, we suggest the following utility of our risk map:

1) risk map can be used to identify potential high priority sites for conservation;
2) risk map can be used to modify existing or proposed conservation areas;
3) risk map can be used to identify existing sites in high risk areas;
4) risk map can be modified for other species; and
5) risk map can be used to increase consistency and repeatability of conservation assessment decisions relative to mapped concerns.

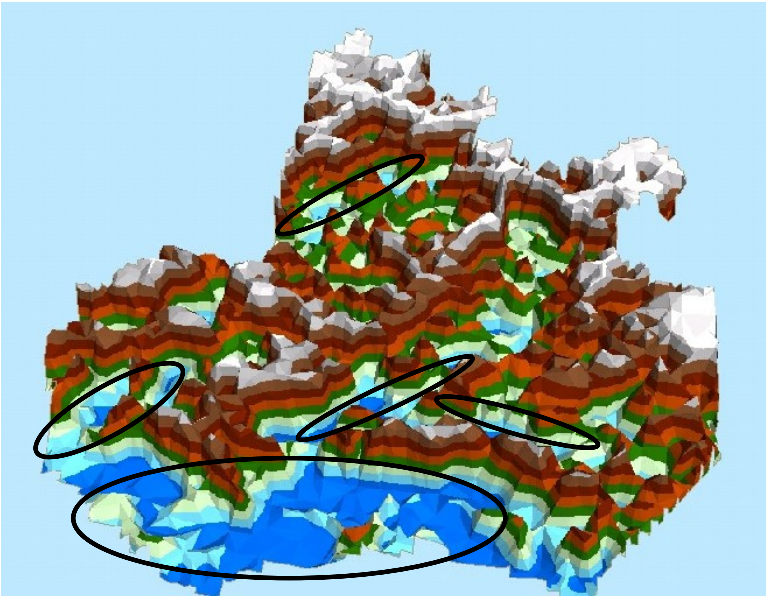

Figure A2.2. Oblique view of conservation risk map for Siskiyou Mountains Salamanders in the Applegate Watershed, southwestern Oregon. Peaks and valleys represent higher and lower risk areas, respectively. Each of 9 color bands represents change in risk of approximately 11 percentiles. For example, the brightest blue areas (see circles) represent areas with the lowest risks to persistence (or grid cells with total risk scores at 11 percentile or lower), whereas the white peaks are areas with the highest risks to persistence (or grid cells with total risk scores at 89 percentile or higher).

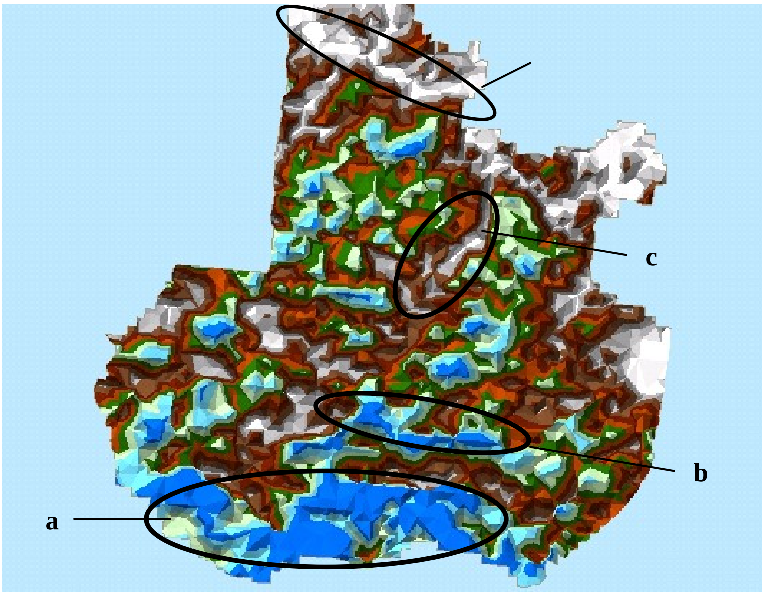

Figure A2.3. A top view of conservation risk map clearly defining the distribution of blue areas with low risk to persistence (or high relative likelihood of persistence) for Siskiyou Mountains salamanders. Landscape patterns that emerge include: a) federal reserves in low fire hazard areas and suitable habitat; b) north-facing slopes resulting in suitable habitat and low fire risk; and c) private lands with less suitable habitats.

Some limitations of the risk map included:
1) future habitat changes were not considered;
2) risk map is not a prediction of actual likelihood of persistence but is a relative measure of likelihood based on user defined risk factors; and
3) a measure of uncertainty was not considered in our risk map.

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Edward Reilly of Medford BLM provided initial GIS layers used in this report.

Appendix 3

High Priority site Identification and Selection Criteria

Watershed Name	Site Id Number	Existing Database Number	Applicable Priority Selection Criteria	Approx. Size of Site (Acre)	Recommended Management Strategy	Comments
Slagle Creek	SL1		F, K	17	2	All sites in watershed peripheral to range; SMA SL1 extends SW of site; in WUI
	SL2		G, H, K, N	27	2	Site adjacent to and inclusive of Riparian Reserve (RR); in WUI
	SL3		F, K, Q	30	2	Northernmost site in watershed (and range), ridgetop; in WUI
	SL4		D, G, H, K, N	67	2	Coincident with 100-acre LSR and RR; in WUI
Thompson Creek	TH1	Merges sites Ollivier 324, 322 323, 294	D, N	23	2	Entire stand above the road in good habitat
	TH2	ISMS 605	F, G, H	25	2	Includes RR, SMA extends NW of site and NW of RR,
	TH3	10002 and 10003	H, I	70	2	In canyon RR, high fire hazard, north facing slope
	TH4	08001	C, H, N	23	2	Near RR, good habitat; good connectivity to next drainage; in WUI
	TH5	318 and 319 and 320, 09002; 09003	D, G, N	130	2	SMA extends southward; best habitat on BLM land, down ridge
	TH6	19001	F, H, N	31	2	Only site in entire canyon; Merged with LSR-100
	Th7	20001; 20002	F, H, N	51	2	In good habitat, but habitat in area limited overall; near RR
	TH8	08B	F, H, N, Q	11	2	Ravine location; fair habitat
	TH9	ISMS 617	F, H	97	2	Totally in owl reserve100-acre LSR

Watershed Name	Site Id Number	Existing Database Number	Applicable Priority Selection Criteria	Approx. Size of Site (Acre)	Recommended Management Strategy	Comments
	TH10	32001	F, N	72	1	Good habitat; large diameter trees
Sturgis Creek	STU1	DCO12	F, H, N	49	1	In 100-acre LSR; near RR; good habitat
	STU2	ISMS 141	H, J, L, N	137	2	2 sites merged; in RR of class 2 stream, NE aspect
	STU3	03C	A, F, H,	8	1	NE facing, remnant habitat, SMA goes northeast to RR
Steve's Fork Creek	STE1	DC010	A, F	27	1	Impacted watershed, remnant habitat, SMA extends S to abut 100-acre LSR;
	STE2	DC011	A, F	23	1	Remnant habitat, SMA extends SE to NE facing slope,
Spencer Gulch	SPN1	ISMS 651	A, F, I, M	23	2	SMA in well defined canyon; good habitat; WUI
	SPN2	17002 18001	A, F, N	52	1	SMA extends north of site; good, contiguous habitat
Middle Fork Creek	MF1	Merged sites 802 and 803	C E, G, I, N	146	Management Strategy 2 along ridgeline approx 200 ft and Strategy 1 down slope along crest,	In Red Butte's Wilderness, large LSR, large contiguous block of high quality habitat that is a species refugia. This area joins RRNF and KLNF and is a key gene flow area as the low point in Siskiyou crest.
	MF2	CVS 2005088; ISMS 156, 807, 808,428 (820); Ollivier 109, 108	E, F, G, N	35	1	Band of sites and habitat along east side of Middle Fork Applegate River in LSR, multiple sites merged
	MF3	66A	F, G, N	111	1	Only site on west side of river in this area, habitat block,
	MF4	Ollivier 135; ISMS 804	F, H	36	1	In RR on south side of river and west side of private block
Middle Fork Creek	MF5	Ollivier 140/ ISMS 809	F, H	36	1	In RR and 100-acre LSR, west side of

Watershed Name	Site Id Number	Existing Database Number	Applicable Priority Selection Criteria	Approx. Size of Site (Acre)	Recommended Management Strategy	Comments
						river, no additional habitat needed other than RR and LSR, merged with due to contiguous habitat
	MF6	Ollivier 141	F, N	151	1	Adjacent to but not in LSR, above road, abutting reserve,
	MF7	Ollivier 122; 64B, 64C	H, N	41	1	Oldest stand in region, small site, south facing slope above it, north side of river, connect 3 sites in riparian area with 2 tree ht buffer,
	MF8	62D	F, H, N	58	1	In RR and 100-acre LSR, west side of river, no additional habitat needed other than RR and LSR, use existing reserve as boundary
	MF9	DC 009; Ollivier 187	F, K, N	46	1	Peripheral in elevation, habitat good, small canyon to connect towards adjacent RR
Dutch Creek	DU1	ISMS 4096	E, N	26	1	In LSR, all very good habitat, access impaired, extensive continuous habitat in LSR
	DU2	ISMS 0644	E, N	19	1	Extensive continuous habitat in LSR
Upper Elliot Creek	UE1	DC 008	A, F, H, K, N	67	1	Refugia in fragmented watershed, SMA to south between 2 RRs and connects to LSR,
	UE2	DC 007; 58C	A, H, K	18	1	Refugia, augmenting existing RR
	UE3	DC 001; DC 004	A, F, K, N	21	1	2 merged sites, elevation periphery and edge periphery
	UE4	DC 003; 56A	A, F, H, K, N	18	1	Augmenting existing RR by 17 ac, 3 sites merged
Lower Elliot Creek	LE1	60B	F, H, I, K, N	36	1	Creek dissects east to west, habitat in south; good site at present,

Watershed Name	Site Id Number	Existing Database Number	Applicable Priority Selection Criteria	Approx. Size of Site (Acre)	Recommended Management Strategy	Comments
						SMA to connect RRs
	LE2	DC 005	A, B, F, I, K	13	1	Next to private, redundancy factor in high fire risk area, so keep because these may be at risk to disturbance, add to riparian areas south and north, fuels reduction should be considered
	LE3	DC 006	A, B, F, I, L	47	1	Species diversity hotspot; diverse herpetile species found at site
	LE4	2005096	A, D, F, A, H	77	1	In LSR, extensive habitat, abutting private, large continuous block north to river,
	LE5	ISMS 159	C, H, N	28	1	In LSR, high quality habitat
	LE6	ISMS 823; Ollivier 131	H, L	31	1	Hutton Guard Station; productive site
	LE7	Ollivier 182		28	1	In LSR, small site, oaks, productive site,
	LE8	59A		26	1	South facing, redundancy, north side of watershed, include RR,
	LE9	ISMS 824; Ollivier 144		41	1	Merged 2 locations, in LSR and in 100-acre LSR, includes RR
Joe Creek	JO1	ISMS 092	A, F H	19	2	In RR and LSR, east of stream, popular collecting area in 50's and 60's (productive site)
	JO2	ISMS 825; Ollivier 145	FCHA	27	1	In LSR, potential for connectivity to northwest to LE9
	JO3	ISMS 093, 094, 095, 645	A, F, H	27	1	In LSR, merging contiguous habitat of 4 sites, on north slope and both sides of stream
Carberry Creek	CA1	39C	A, H, N	91	1	Augment 100-acre LSR and RR with small strip (7 ac) in

Watershed Name	Site Id Number	Existing Database Number	Applicable Priority Selection Criteria	Approx. Size of Site (Acre)	Recommended Management Strategy	Comments
						between, north facing slope
	CA2	36C	A, H, N	88	2	Along RR, borders WUI
	CA3	ISMS 146	A, F, H	29	2	In RR, in WUI, SMA along RR above road
	CA4	ISMS 147, 806; Ollivier 215	A, F, H, N	23	2	Merging 2 sites in RR and 100-acre LSR, augment reserves on west side of creek in SE facing slope by about 4 ac, in WUI,
	CA5	37C	A, F, H, N	37	2	In RR adjacent to 2 100-acre LSRs, no additional habitat needed, in WUI
	CA6	ISMS 615	A, F, H, N	22	1	Augment RR by 4 ac on north side of creek and south side of tributary junction by 15 ac
Humbug	HU1	3904w 02002	N, I	40	1	In WUI; High fire zone due to high canopy; Nice habitat
	HU2	3904w12004, 12003; 12005	N	99	1	Contiguous habitat patch with other known sites
	HU3	3903w06001; 3903w06002; ISMS 829	C, E, N	49	1	In RR and LSR-100; contiguous habitat with other known sites
	HU4	Bury 014, Ollivier 295	E, N	90	2	In LSR-100; large block of habitat
	HU5	3903W05004	F, G, E, J, K	37	2	Augment RR
	HU6	16B	A, B,	10	2	In RR,, bottom and small canyon
Palmer Creek	PA 1	Ollivier 162, ISMS 810	E, F, J, N	19	2	On edge of sub-watershed and in WUI, associated with developed recreation site
	PA2	ISMS 638	J, N, L	11	2	Large area of good habitat, productive site; in WUI but on other side of river from community
	PA3	34D	E, F	34	2	Close to the heart of the range; in RR
	PA4	31A	F, N	37	1	Close to the heart of the range; in Kinney

Watershed Name	Site Id Number	Existing Database Number	Applicable Priority Selection Criteria	Approx. Size of Site (Acre)	Recommended Management Strategy	Comments
						Creek; large block of habitat
	PA5	ISMS 145; 29B	E, F	29	1	Close to the heart of the range; in RR and LSR-100
	PA6	30A	E, F, N	37	1	Close to the heart of the range; adjacent to RR; large block of habitat
	PA7	32D	F, I	59	2	Close to heart of range; south facing slope, high fire risk; variety of conditions to maintain
	PA8	ISMS 602	F, I, N	67	1	In RR, moderate risk from fire; large site
	PA9	27A	E, F, N	55	1	Close to the heart of the range; in RR and LSR-100
	PA10	33B	E, F	18	2	Close to the heart of the range; in RR
Beaver Creek	BE1	25D	E, F, N	16	1	Good habitat extends eastward of site; at edge of LSR-100 and RR
	BE2	ISMS 817; Ollivier 238	J, N	28		Small but productive site; moderate fire zone (in WUI)
	BE3	Ollivier 240	J, N	25	2	In WUI; large bock of habitat
	BE4	ISMS 814	F, N	28	2	Good habitat to the west and south east
	BE5	Ollivier 168	E, F, N	25	2	Good habitat; in RR
	BE6	ISMS 815; Ollivier 176	E, F, N	33	1	In RR and near LSR-100
	BE7	ISMS 812, 816, Ollivier 177, 179	E, L, N	104	1	Good habitat;10 herptile species detected, high diversity; in LSR-100
	BE8	39003W33002	B,C,D,E,F,J,M,N	20	2	Good habitat, RR
	BE9	3903W34b0006	B,C,D,E,F,J,M,N	17	2	RR, in head of drainage
	BE10	3903W35Bo021	B,C,D,E,F,J,M,N	37	1	GOOD HABITAT , Connects 2 RRs
Applegate Lakefront	AP1	Ollivier 291	N	56	1	Good habitat; high risk and hazard; north slope old-growth (300 years)
	AP2	ISMS 819	E, F, I, N	48	1	Good habitat in RR and in developed

Watershed Name	Site Id Number	Existing Database Number	Applicable Priority Selection Criteria	Approx. Size of Site (Acre)	Recommended Management Strategy	Comments
						recreation site; small site with moderate fire risk
	AP3	ISMS 824	I, N	66	1	Productive site; high risk and hazard, adjacent to lake with high public use
	AP4	41A	E, F, I, N	29	1	In RR; adjacent to private land; moderate risk for fire
	AP5	40B	E, F, N	33	2	In RR, small site in developed recreation site
Squaw Creek	SQ1	48A	E, F	21	2	In RR and LSR-100
	SQ2	47A	E, F	25	1	Habitat extends northwest; in RR and LSR-100
	SQ3	46A	E, F	23	1	Habitat extends south to north facing slope; in RR and LSR-100
	SQ4	45A	E, N	78	1	In RR and LSR- 100; good habitat in north facing canyon
	SQ5	44A, 44B	E	36	1	In RR and LSR- 100
	SQ6	51B	A, F, N	51	1	Only site in north end of watershed
Star Gulch	ST2	Bury 017	A, B, C, E, G, N, L	23	1	Adjacent to LSR-100
	ST3	3904W18001	B, C, D, E, F, M, N	29	2	Adjacent to LSR-100
	ST4	11A	B, C, D, E, F, M, N	40	1	Adjacent to LSR-100
	ST5	Bury 016	B, E, F, G, M, N	43	1	Habitat extends northwest from site; in RR
	ST6	60000134/ 60000592	B, E, F, G, M, N	28	1	In RR two-merge adjacent sites
	ST7	12A	B, C, D, E, F, G	25	1	In RR
	ST8	60000591	B, D, E, F, G, L, J	35	2	In RR
	ST9	3903W23001AS HRA	B, D, E, F, I, M, N	48	2	In RR
	ST10	3903W26BO025	B, C, D, F, G, J, L, N	181	2	In RR; large site to merge with 7 other points (ISMS 3903W27bo024; 3903W26bo028; 029; 030; 026; 027; 031)
	ST11	10A	G, A, M, N,	27	1	In RR
Star Gulch	ST12	13C	G, A, M, N,	37	2	In WUI, RR. Low

Watershed Name	Site Id Number	Existing Database Number	Applicable Priority Selection Criteria	Approx. Size of Site (Acre)	Recommended Management Strategy	Comments
						elevation
	ST13	3903w08002	B, G, A, M, N,	14	2	In WUI, in RR,
Lower Little Applegate	LLA1	60000832/ Ollivier 112	B, D, E, F, G, J, L, M, N	57	1	In LSR-100
	LLA2	60000623	A, B, D, E, K, L, M, N	31	1	Merge with 3 other BLM sites in RR (ISMS 3903W25bo035; 3903W26bo036; 3903W36bo038
	LLA4	ISMS 3903W24bo052	B, D, F, G, J, K, M, N	24	2	Use upper BLM site for plot
	LLA5	18F/ 60000624	B, D, E, G, J, K, J, L, N	50	2	In RR; edge of range
	LLA6	ISMS 3903W25bo047; ISMS 3903W25bo048	B, D, E, H, J, K, L, M, N	34	2	In RR, canyon, north facing, habitat extends to the east
	LLA7	ISMS 3903W36bo0485	A, D, E, K, M, N	25	2	Merge with other sites ISMS 3903W36bo044; 3903W36bo046
Yale Creek	YA1	60000155	A, B, C, D, F, G, H, J, K, M, N	45	2	In RR; edge of range, use RR for site

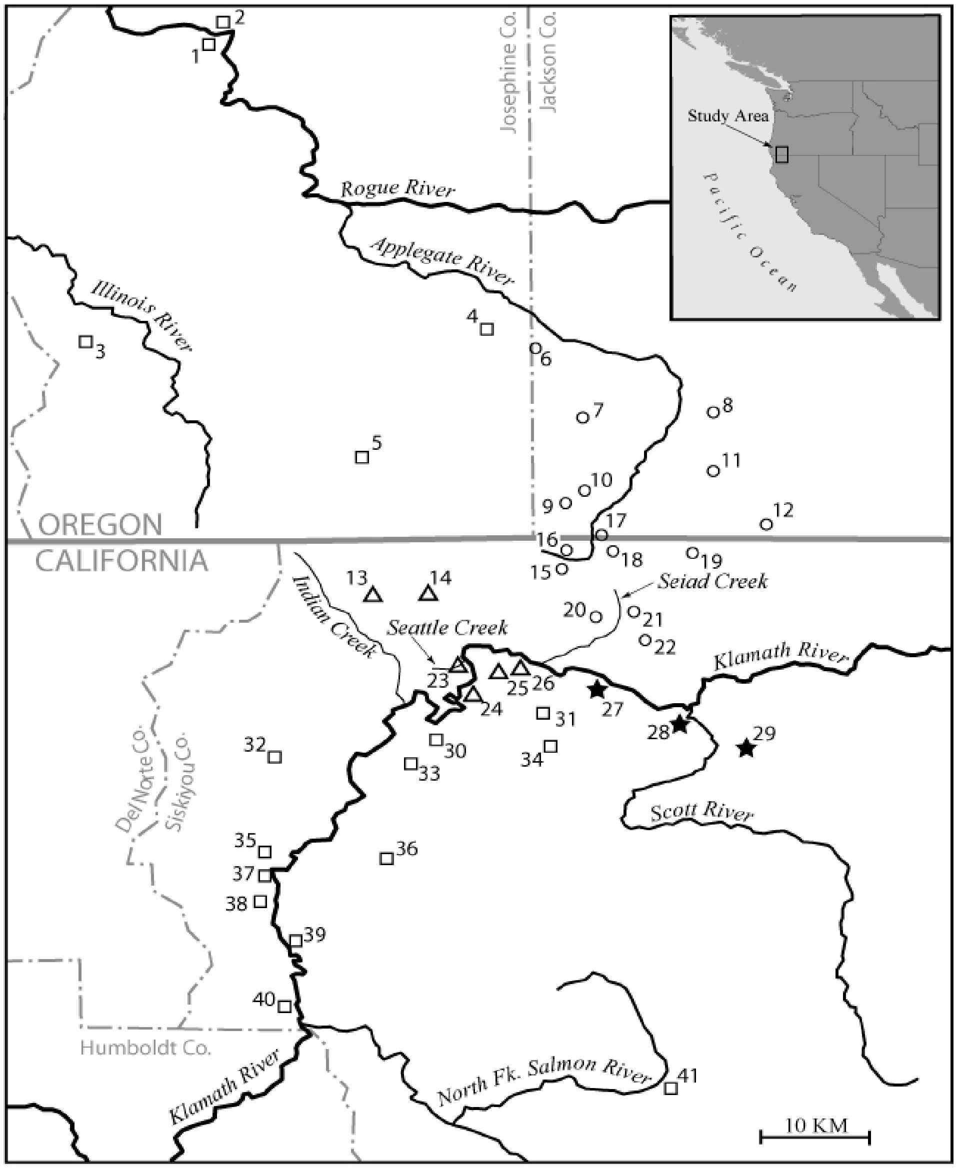
Appendix 4

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

An overarching goal of the SSS program is to prevent a need to list a given species under the Endangered Species Act (ESA). Fuels treatment activities near at-risk communities were evaluated relative to range-wide species potential for activities that could lead to a need to list under the ESA as well as site-level persistence.

For the Siskiyou Mountains salamander, known sites were evaluated relative to our knowledge of distinct populations (Pfrender and Titus 2001, Mead et al. in press, Degross 2004). Persistence of each of three distinct populations 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 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 site. A higher risk to a portion of a site may not result in loss of that site.

Three distinct genetic lineages of salamanders have been determined within the range of this species (Pfrender and Titus 2001, Mead et al. in press). The groups are identified as the Applegate Group, the largest group with the most extensive range and number of sites, the Grider group, and the Scott Bar group (Figure A4.1). The Grider/Scott Bar groups are typified by low numbers of occupied sites, relative to the Applegate group, and high levels of genetic diversity. Management considerations for fuels management treatments near at-risk communities described here are applicable only to the Applegate Group.



Map Key

Squares = *P. elongatus*
Circles = *P. stormi*/Applegate Group
Triangles= *P. stormi*/Grider Group
Stars = *P. asupak*/Scott Bar Group

Figure A4.1. Distribution of *Plethodon* species and discrete populations of *Plethodon stormi* in the *P. stormi* range.

Management within Habitat Areas

Most treatments are considered to be "low risk" to species sites in 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 under the federal Endangered Species Act. Treatments are specific to the Applegate Group of Plethodon stormi because this is the only population covered by this Conservation Strategy.

The Applegate Group is the largest group with the most extensive range and number of sites. Consequently, a more flexible approach to fuels management may be appropriate. The 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. All applicable mitigation criteria should be used. Activity-specific mitigations are discussed below.

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 contiguous suitable 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 disturbing activities 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 are only allowed 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, Medford District BLM, Ashland Resource Area. March 27, 2002, 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).

For the Applegate Group, 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, the following measures are recommended.

- *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 piles 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 recommended for this activity unless pruning is done using heavy machinery. If so, the mitigations listed above apply.

- *Understory Thinning* - Within known sites canopy closure mitigations do not apply to manual thinning of suppressed understory trees and ladder fuels. Ground-disturbance mitigations (20% of a known site) apply to all activities associated with mechanized understory thinning (yarding, temporary road construction, landings, etc).

- *Chipping* - Within known sites there are no mitigations recommended for this activity unless the machine is hauled into a known site by heavy equipment. If so, then the ground disturbance mitigations listed above (ground disturbance limited to less than 20% of the known site) apply.

- *Raking* - Within known sites there are no mitigations recommended for this activity.

- *Hand Firelines* - Hand firelines at known sites should be limited to 20% of the known site.

High Risk Treatments

Some treatments within the 1-1 ½ mile fuels treatment zone (including the critical first 300 feet) surrounding developments and structures associated with a community could result in risk or loss of an occupied site and would not likely lead to a need to list under the ESA.

High risk treatments that could result in the loss of a site could be applied to up to 20% of the known sites within any 6th field watershed with 5 or more known sites. However, the amount of suitable habitat (unsurveyed and/or occupied) within those sites treated may 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 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.

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