Petition to List the Siskiyou Mountains Salamander (*Plethodon stormi and asupaki)* as Threatened or Endangered under the Endangered Species Act

Petitioners:

Center for Biological Diversity
Klamath-Siskiyou Wildlands Center
American Lands Alliance
Cascadia Wildlands Project
Environmental Protection Information Center
Northwest Ecosystem Alliance
Oregon Natural Resources Council
Siskiyou Regional Education Project

June 16, 2004

Ms. Gale Norton
Secretary of the Interior
Office of the Secretary
Department of the Interior
18th and "C" Street, N.W.
Washington, D.C. 20240

CC: Dave Allen, Regional Director
US Fish and Wildlife Service
911 NE 11th Ave
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Ms. Norton,

The Center for Biological Diversity, Klamath Siskiyou Wildlands Center, American Lands Alliance, Cascadia Wildlands Project, Environmental Protection Information Center, Northwest Ecosystem Alliance, Oregon Natural Resources Council, Siskiyou Regional Education Project and Noah Greenwald hereby formally petition the U.S. Fish and Wildlife Service (USFWS) to list the Siskiyou Mountains Salamander (*Plethodon storm and asupaki*) as threatened or endangered pursuant to the Endangered Species Act (herein after the "Act" or "ESA"), and to designate critical habitat for it concurrent with listing. Petitioners file this petition under the ESA, 16 U.S.C. sections 1531-1543 (1982). This petition is filed under 5 U.S.C. section 553(e), and 50 C.F.R. part 424.14 (1990), which grants interested parties the right to petition for issuance of a rule from the Assistant Secretary of the Interior. The petitioners request that Critical Habitat be designated as required by 16 U.S.C. 1533(b)(6)(C) and 50 CFR 424.12, and pursuant to the Administrative Procedures Act (5 U.S.C. 553). Petitioners realize this petition sets in motion a specific process placing definite response requirements on the USFWS and very specific time constraints upon those responses.

The U.S. Fish and Wildlife Service have several options for listing the Siskiyou Mountains salamander. They can either list the species because it is threatened or endangered in all of its range, or because it is threatened or endangered in a significant portion of its range. They also can list one or more of three distinct population segments (DPS) of the species. Information presented in this petition indicates that all three populations warrant listing as either threatened or endangered. One of the DPS is currently being considered for recognition as a full species (*P. asupaki*, Mead et al. In review). If this species should be recognized before a determination on listing has been made, this petition should be considered to include the new species.

Addressing the decline of the Siskiyou Mountains salamander by listing them under the ESA will serve to restore and maintain the health not only of this unique species, but of native terrestrial ecosystems in the watersheds subject to this petition.

Petitioners:

The petitioners are conservation organizations. Failure to grant the requested petition will adversely affect the aesthetic, recreational, commercial, research, and scientific interests of petitioning organizations' members and of the citizens of the United States.

Aesthetically, recreationally, and commercially, the public shows increasing demand and concern for wild ecosystems and for biodiversity in general.

Center for Biological Diversity is a conservation organization dedicated to preserving all native wild plants and animals, communities, and naturally functioning ecosystems in the Northern Hemisphere.

Klamath Siskiyou Wildlands Center is a tax-exempt, non-profit public interest organization with over 400 members. Its mission is to protect the biodiversity and wild areas of the Klamath-Siskiyou region and its interregional connections. Our campaigns, the Public Lands Oversight and Biodiversity Campaigns, are designed to curb the loss of ecological elements of natural systems.

American Lands Alliance works with conservation organizations and citizens nationwide to protect and recover our wildlife and wild places.

The Cascadia Wildlands Project works to protect biodiversity in the Pacific Northwest. We have over 500 members and offices in Eugene, OR and Cordova, AK.

Environmental Protection Information Center (EPIC) is a community-based, non-profit organization dedicated to the protection and restoration of the watersheds, biodiversity, native species, and natural ecosystems of the North Coast of California. EPIC was formed in 1977 and currently has more than 3,000 members.

Northwest Ecosystem Alliance (NWEA) was established in 1988 and is a non-profit 501(c)(3) public interest organization incorporated in the State of Washington. NWEA and its 8,000 members are dedicated to the protection and restoration of biological diversity. NWEA conducts research and advocacy to promote the conservation of sensitive and endangered wildlife and their habitat in the northern Pacific region.

Oregon Natural Resources Council works to aggressively protect and restore the wildlands, wildlife, and waters of the Greater Oregon Ecosystem as an enduring legacy.

Siskiyou Regional Education Project works to protect, preserve and restore the wild free flowing rivers and wildlands of the Siskiyou Mountains and the region's globally important biological diversity and rare plants.

EXECUTIVE SUMMARY

The Siskiyou Mountains salamander (*Plethodon stormi*) has the narrowest range of any western *Plethodon* salamander. Within this range, suitable habitat is patchily distributed and the species only occurs in a portion of available habitat. The salamander has low vagility, a slow reproductive rate, and is associated with late-successional forest conditions, making it sensitive to logging and other forest disturbances. Together, these factors place the Siskiyou Mountains salamander at risk of local, regional and ultimately global extinction.

Genetic studies of *P. stormi* identified three distinct population segments, one predominantly north of the Siskiyou Crest in Oregon and two south of the Crest in California. One of these is being described as a new species (*P. asupaki*). All three distinct population segments and the species as a whole meet at least three of the five factors for determining a species is threatened or endangered in all or a significant portion of its range:

The Present or threatened destruction, modification or curtailment of the Siskiyou Mountains salamander's habitat or range.

Logging is considered the principle threat to the continued existence of the Siskiyou Mountains salamander. The species is a narrow habitat specialist that requires a combination of late-successional forest conditions, talus substrate, and an appropriate climactic setting. By altering stand microclimate through canopy removal and by compacting or otherwise impacting talus substrates, logging renders habitat unsuitable for Siskiyou Mountains salamanders, resulting in sharp population declines or local extirpation.

Other factors, such as road building, mining, recreation and construction of the Applegate Dam, have and continue to impact Siskiyou Mountains salamander populations.

Other natural or manmade factors affecting the continued existence of the Siskiyou Mountains salamander

The Siskiyou Mountains salamander evolved in an environment with frequent fires. Fire suppression over the last 50 years, however, has in some cases resulted in fuel loadings that may place some Siskiyou Mountains salamander habitat at risk of stand-replacing fire. In combination with habitat loss from logging, this increases the species risk of extinction.

Habitat for the Siskiyou Mountains salamander is in part determined by regional climate. Predictions for global warming predict a 1.5-6°C rise in the average global temperature with increases in the western United States predicted to be greater than average. This may further fragment the already patchy nature of existing populations. The low vagility of the Siskiyou Mountains salamander makes it unlikely that it will simply be able to shift its

range in response to rising temperatures. Global warming is an additional threat to the continued existence of the Siskiyou Mountains salamander.

Inadequacy of existing regulatory mechanisms to protect the Siskiyou Mountains salamander

Although roughly 80% of the salamander's range occurs on federal lands, very little of its habitat is protected. Less than 10% of presumed high quality habitat is found in reserves. The Siskiyou Mountains salamander was formerly protected by the Survey and Manage Program of the Northwest Forest Plan, which required surveys for the species and management of its habitat. In March 2004, the Bush Administration eliminated the Survey and Manage Program, leaving the Siskiyou Mountains salamander with little to no regulatory protection on federal lands.

On private and state lands, the Siskiyou Mountains salamander currently receives no formal protection in Oregon. In California, the species is currently listed as threatened under the state Endangered Species Act. This provides protection comparable to federal listing. California Department of Fish and Game, however, has proposed to remove the species from the threatened list, which would leave it without substantial protection in the state.

In combination, these factors demonstrate the Siskiyou Mountains salamander warrants listing as a threatened or endangered species under the Endangered Species Act.

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I. INTRODUCTION

The Siskiyou Mountains salamander plays a critical role in the ecology of forests and is an irreplaceable element of the biologically rich and world-renowned Klamath-Siskiyou Mountains. By regulating the composition and abundance of soil invertebrates that are responsible for the break-down of plant detritus, *Plethodon* salamanders play a key role in forest nutrient flow (Burton and Likens 1975a). Salamanders are also an excellent source of energy for their predators. Salamanders eat prey that because of its size and occurrence in soil is unavailable to larger organisms, and are highly efficient at converting consumed prey into new tissue. In optimal habitat, the biomass of *Plethodon* salamanders can be greater than that of either birds or small mammals (Burton and Likens 1975b). In sum, loss or decline of *Plethodon* salamanders from forest ecosystems because of logging or other factors likely has important consequences both up and down the food chain.

Welsh and Droege (2001) argue *Plethodontid* salamanders are excellent indicators of ecosystem integrity and biodiversity because they are relatively easy to sample, have small home ranges and high site fidelity, and are sensitive to anthropogenic perturbations. The Siskiyou Mountains salamander is no exception. The species is associated with late-successional forests and like many species of *Plethodon*, sensitive to logging (e.g. Welsh 1990, Dupuis et al. 1994, deMaynadier et al. 1995, Ash 1997, Herbeck and Larsen 1999, Ollivier et al. 2001, USDA, USDI Species Review Panel 2001 and 2002). Its loss from forested stands following logging or other disturbances indicates changes in stand microclimate that likely affect a broad array of species that are more difficult to study.

Protecting the Siskiyou Mountains salamander as a threatened or endangered species under the Endangered Species Act will ensure that it continues to play a vital role in the forested ecosystems of the Klamath-Siskiyou and help to preserve the natural heritage of this biologically rich area.

II. NATURAL HISTORY AND ECOLOGY OF THE SISKIYOU MOUNTAINS SALAMANDER

1. Taxonomy

The Siskiyou Mountains salamander was first discovered in 1963 and described as a separate species in 1965 (*Plethodon stormi*, Highton and Brame 1965). Based on apparent clinal variation in color and morphology, Bury (1973) questioned the recognition of *P. stormi* as a full species and suggested that it be considered a "distinct group" of the closely related Del Norte salamander (*P. elongatus*). Stebbins (1985) subsequently considered Siskiyou Mountains salamander to be a subspecies of the Del Norte salamander (*P. e. stormi*), but provided no further information. Others continued to recognize *P. stormi* as a separate species (Nussbaum et al. 1983, Leornard et al. 1993), and recent morphological and genetic studies have confirmed species level differences between *P. stormi* and *P. elongatus* (Bury 1998, Pfrender and Titus 2002, DeGross 2004, Mahoney 2004, Mead et al. In review). Mahoney (2004), for example, concluded:

> "Morphological boundaries between *P. elongatus* and *P. stormi* are largely congruent with mitochondrial DNA breaks and continued treatment as sister taxa is supported."

Similarly, DeGross (2004) based on an analysis of microsatellites, concluded:

> "Multivariate analyses of the 11 microsatellite loci lend strong support to the view that *P. elongatus* and *P. stormi* are distinct species."

Accordingly, the best available science, as represented in published studies (e.g. DeGross 2004, Mahoney 2004, Mead et al. In review), recognizes *P. stormi* as a full species.

2. Description

The Siskiyou Mountains Salamander is a long-bodied, short-limbed terrestrial salamander with a high tooth count and a broad, short head that closely resembles *P. elongatus* (Nussbaum et al. 1983). Juveniles are black, with a sparse to heavy sprinkling of white flecks, especially on the head and sides. The dorsal stripe is a zone of dull gold flecks. Its edges are straight, but they are not sharply defined, and the stripe fades out on the head and tail. Adult P. stormi have a very long body with a mode of 17 costal grooves, and the tail is about as long as the head and body (shorter in females) and lacks constriction at the base (Brodie 1970). The legs are short, and the feet are separated by 4-5.5 intercostal folds if the legs are adpressed. Toes are short and round. The outer (fifth) toe on the hind foot is about one-third the length of the fourth toe. Adults are pink-tan or pink-gray to light brown (also described as chocolate brown and light-purplish brown). There is a sparse to generous sprinkling of white flecks or small patches, especially on the head and sides. The dorsal stripe (if present) is vague, and it is composed of pinkish or golden-tan dots. Adults may reach a total length of 102-152 cm (4-6 inches)(Nussbaum et al. 1983).

3. Reproduction and Growth

Siskiyou Mountains salamanders are fully terrestrial salamanders, which have completely abandoned the aquatic larval stage. They manage this by depositing eggs in moist, protected subterranean sites, such as cracks in rock rubble or talus slopes. When juvenile salamanders hatch, they are already metamorphosed into fully terrestrial salamanders. Limited data suggests that females lay eggs every other year, beginning at five years old (Nussbaum 1974). Females brood their embryos throughout the summer, mating occurs during the winter, eggs are laid in the spring, and hatch in the fall. In captured females, the clutch has averaged 9, ranging from 2-18 eggs (Nussbaum 1974). The low reproductive rate of the Siskiyou mountains salamander makes it particularly vulnerable to stochastic and anthropogenic events that reduce breeding success or individual survival, placing the species at additional risk of extinction.

4. Movement

Siskiyou mountains salamanders complete their life cycles in an area less than 2.5 acres and have not been observed migrating between subpopulations (Nussbaum 1974). In a study of the closely related *P. elongatus*, Welsh and Lind (1992) found that of a total of 54 captured salamanders, the majority (66% of males and 80% of females) remained in the same 7.5 x 7.5 m square over the course of a two year study. The remainder of salamanders were found in adjacent squares, except one male that moved across two squares for a total distance of 36.2 m over six months. Moreover, Mead et al. (In review) found genetic differences between individuals separated only by the Seiad Valley had evolved separately for as long as 3-4 million years. These results indicate Siskiyou Mountains salamanders complete their life cycle in a very small area and have a limited ability to disperse between populations or habitat, making them particularly vulnerable to local population extirpation from habitat disturbance or other factors with little hope for habitat recolonization.

P. stormi's movements are highly dependent on moist microhabitats. Hence, fully terrestrial salamanders such as *P. stormi* are usually only active during fall or spring rainy seasons or at night when temperatures are low and humidity high. During the day they hide under surface objects, in cracks, or buried in talus and soil, often in burrows made by other animals. In spring and fall when the soil is wet they are often close to the surface, but during the summer and winter they retreat to considerable depth to escape heat and drought in the former and freezing in the latter seasons (Nussbaum 1974).

5. Feeding

Salamanders are an important component of the food web in many forest ecosystems and evidence indicates that they constitute the single most important vertebrates whose size enables them to exploit prey too small and inaccessible to be used by most birds and mammals, and subsequently convert these prey into biomass that is available to larger vertebrates (Pough 1983).

P. stormi is a sit and wait predator, concealing themselves under small cover objects or at burrow mouths. This behavior requires adequate burrow systems and cover objects to be successful. No systematic studies of *P. stormi's* diet have been conducted, but it likely consists of spiders, mites, ants, collembolans, beetles and other invertebrates. *P. stormi* searches for its food on damp soil and under ground debris.

6. Population genetics

In a study of the population genetics of the Siskiyou Mountains salamander, Pfrender and Titus (2002) found three distinct lineages within *P. stormi*. Two of the three lineages are found south of the Siskiyou Mountains crest in the Klamath River drainage in California and the third is found in the Applegate River drainage in Oregon and adjacent Klamath Drainage in California. Pfrender and Titus (2002) conclude:

> "Within P. stormi there are three distinct genetic groups. The first (Group I) comprises the two unique haplotypes from the Applegate River drainage. These haplotypes are most closely related to a monophyletic clade (Group II) of haplotypes found in populations south of the Applegate River and west of Grider Ridge. These haplotypes are found both north and south of the Klamath River. A third monophyletic grouping (Group III) of haplotypes comprises individuals from south of the Klamath River and east of Grider Ridge."

Observed variation between the groups, in particular differences between Group III and the other populations, were comparable to species level differences with Pfrender and Titus (2002) concluding:

> "this lineage [Group III] has an average sequence divergence in excess of 12% from other *P. stormi/elongatus* lineages. Assuming a relatively rapid molecular clock for the gene region we examined this level of divergence conservatively reflects 3-4 million years of independent evolution for this clade. These factors taken together suggest that a taxonomic revision of this species complex may be warranted."

Pfrender and Titus were equivocal about how the taxonomy of *P. stormi* and *P. elongatus* should be revised proposing four possibilities, including one that lumped *P. stormi* and *P. elongatus* with four distinct population segments and another that recognized Group III *P. stormi* as a third species. Ultimately, Pfrender and Titus (2004) conclude that management must recognize distinct genetic lineages to preserve the species:

> "Regardless of the taxonomic assessment it is clear that there are at least four genetically distinct population segments in the *P. elongatus/stormi* complex… The available evidence suggests that distinct genetic groups identified by this study should be treated as separate units for management considerations. The highest priority should be given to populations of Group III *P. stormi*. These populations exhibit the highest level of divergence observed in the complex and occupy the most restricted geographic range."

Further genetic work has upheld recognition of *P. stormi* as a distinct species, and confirmed the presence of three distinct lineages within *P. stormi* (DeGross 2004, Mahoney 2004, Mead et al. In review). Mead et al. (In review) documented sufficient variation to recognize Group III *P. stormi* as a new species (*P. asupaki*). If this work should be accepted for publication before a decision on this petition is issued, we consider this petition to cover the newly recognized species, as well as populations remaining as *P. stormi*. Using microsatellites, DeGross (2004) studied the contact zones between the two remaining populations of *P. stormi*, finding clear evidence for distinct population segments, stating:

> "The canonical discriminant analysis revealed strong separation of the two *P. stormi* clades on the second canonical variable. This multivariate analysis lends support to the separation of the two *P. stormi* clades as distinct, differentiated

> lineages, as well as additional support for *P. elongatus* and *P. stormi* as separate species. The data presented here, support the presence of two differentiated groups within *P. stormi*, which further support the mtDNA analysis from Mead *et al* (2004). Although these two groups may not be biological species these two units should receive recognition because of their ecological and evolutionary significance. Distinct differentiation of these two clades in their mtDNA and microsatellite loci warrants the designation of Evolutionary Significant Units (ESUs) (Moritz 1994)."

The other significant finding of genetic studies of *P. stormi* is a finding by Pfrender and Titus (2002) that populations of Group I *P. stormi* found in the Applegate River and comprising a majority of known sites of the species have very low genetic variability. They conclude:

> "The most striking feature of our study is the almost complete lack of genetic variation observed within and among populations of the Siskiyou Mountains salamander in the Applegate drainage… While it is not uncommon for specific populations to have low levels of genetic diversity, it is very rare indeed for multiple populations comprising the bulk of the range of a species to show such lack of variation."

Pfrender and Titus (2002) reason that the most likely cause for the low level of genetic variation in Group I *P. stormi* is recent expansion of the Siskiyou Mountains salamander into the Applegate River Watershed by a small number of individuals causing a genetic bottleneck. These types of bottlenecks are referred to as founder effects. Regardless of the cause, the low genetic variation found in Group I *P. stormi* is of substantial conservation concern because it indicates the species may have a limited capacity to adapt to environmental change related to climate change or other factors, further highlighting the need to ensure the survival of all distinct population segments of the Siskiyou Mountains salamander.

7. Distribution

The Siskiyou Mountains salamander has the smallest range of any western *Plethodon* salamander. The species occupies a known range of roughly 203,000 hectares in three counties (Jackson, Josephine and Siskiyou) in extreme southwestern Oregon and northwestern California (Nauman and Olson 1999, USDA, USDI Species Review Panel 2002). Its distribution includes the southern portion of Applegate River drainage in southern Oregon and drainages in the Klamath River in northern California. It is bounded on the northeast by the Rogue River valley and in the east by the distribution of the Del Norte salamander. It is found in a few drainages south of the Klamath River in the Scott River and Grider Creek drainages. *P. stormi* is primarily found below 1,000 m in elevation, but has been observed up to 3,000 m (Clayton 1999, Nauman and Olson 2004a and b).

Within this narrow range, suitable habitat comprises a minority of the total landscape further restricting the species' distribution. Nussbaum (1974) estimated only three percent of the species' known range is suitable habitat. Pre-disturbance surveys for the Siskiyou Mountains salamander found that suitable habitat occupied anywhere from 3-14% of planning areas in the northern portion of *P. stormi's* range (USDA, USDI Species Review Panel 2001). A preliminary habitat model for *P. stormi* predicted suitable habitat occupies 30% of the species range in the Applegate River (USDA, USDI Species Review Panel 2002). Similar estimates have not been made for the southern portion of the species range.

Restricting the Siskiyou Mountains salamanders distribution further, the species is only found in a portion of suitable habitat. Ollivier et al. (2001) sampled 239 randomly sites with suitable substrates in forested habitat for Siskiyou Mountains salamander and found only 27% were occupied by the species. Using a more refined habitat definition and a different survey approach, Nauman and Olson (2004a) similarly found *P. stormi* on 26% of randomly selected sites on federal lands in California. Nauman and Olson (2004b) found *P. stormi* at 65% of "optimal" habitat sites on federal lands in the Applegate drainage, where the species appears to occur more commonly. The limited and highly fragmented distribution of the Siskiyou Mountains salamander in combination with its limited dispersal ability, places the species at further risk of extinction, especially in California.

Given that the Siskiyou Mountains salamander was only described in 1965 and has only received attention in the last 5-10 years, little is known about its historic distribution. Populations were known to be inundated, including the type locality, when Applegate Dam was constructed, and other sites have likely been lost because of logging, mining, road construction and other factors (USDA, USDI Species Review Panel 2001), but the extent of such loss is unknown.

Although about 80 percent of the Siskiyou Mountains salamander's range occurs on federal land, a majority of known sites and habitat is unprotected. Of known sites, 77% occur within non-protected land allocations (USDA, USDI Species Review Panel 2002). Of particular concern, 65% of the known range and 30% of known sites of Group III *P. stormi* (*P. asupaki*), which is the most genetically divergent population, occurs on matrix or private lands (USDA, USDI Species Review Panel 2001). Because many reserved lands occur at higher elevations, many of the sites that are found in reserves may occur in sub-optimal habitat for *P. stormi* with potentially lower abundance.

8. Habitat Requirements

Nussbaum (1974) broadly characterized the habitat of *P. stormi* as "stabilized talus in old-growth stands on N-, NE-, or NW-facing slopes." A recent and extensive study of Siskiyou Mountains salamander habitat-use largely corroborates Nussbaum's general observation (Ollivier et al. 2001). Using a systematic, stratified, random sampling design that focused on sites with suitable substrates, Ollivier et al. (2001) sampled 239 sites both north and south of the Siskiyou crest for salamander presence and used discriminant and

regression analyses to determine habitat characteristics predictive of salamander presence at landscape, macrohabitat and microhabitat scales. Based on this extensive study, Ollivier et al. (2001) conclude:

> "Overall, our results indicated a significant association of the Siskiyou Mountains salamander with conditions found in older, undisturbed forest with a closed canopy, moist microclimate, and rocky substrates dominated by cobble-sized pieces. These habitat attributes appear optimal for reproductive success and long-term survival throughout the range of this species. The Siskiyou Mountains salamander may require those ecological conditions found primarily in late-seral forest."

Plethodon salamanders in general and *P. stormi* in particular breathe through their skin. To facilitate respiration, their skin must be in contact with moist substrate or individuals begin to dehydrate (Spotila 1972, Feder 1983). These physiological requirements largely explain the species requirements for talus slopes, shaded by late-seral forests that maintain a cooler and more stable microclimate (Feder 1983, Chen et al. 1993)

At the landscape scale, Ollivier et al. (2001) found that latitude, elevation, years since disturbance and average annual precipitation best predicted *P. stormi* presence in California and that longitude and aspect best predicted *P. stormi* presence in Oregon. Sites in California occurred more in the southern and eastern portion of the species range, were lower in elevation, had greater time since disturbance (disturbance was related to logging in all instances), and had higher mean precipitation than sites where salamanders were not found. In Oregon, sites with salamanders occurred more in the northern portion of the species range and were more likely to occur on a north aspect than sites without salamanders. Ollivier et al. (2001) believed these characteristics reflected interactions between the prevailing climate, the distribution of habitats on the landscape and the physiological requirements of the Siskiyou Mountains salamander, concluding:

> "The condition of the landscape as a mosaic of varyingly suitable habitats and the relationship between those habitats and the prevailing weather, determines the various microclimates available to organisms which inhabit a landscape. The length of time that equable surface microclimatic conditions are within the tolerance limits of terrestrial salamanders is probably the single most important aspect of their biology, because it can affect both the density of individuals within a site and the density of occupied sites on the landscape. Shortened periods of surface conditions appropriate for feeding and breeding activities can limit both survivorship and recruitment… It is likely that salamanders living at sites with microclimatic conditions limiting the duration of surface activity will take longer to achieve the body mass and fat reserves necessary for reproduction. Most recently disturbed sites we sampled appeared to lack the microclimatic conditions necessary for persistence of the species over time."

This statement indicates the Siskiyou Mountains salamander is a narrow habitat specialist that is severely impacted by disturbances that influence microclimate, including logging.

At the macrohabitat scale, Ollivier et al. (2001) found that sites in California had greater minimum Douglas-fir diameter, more small decayed conifer logs, greater proportional area of rock, less gravel, lower solar index, greater canopy cover and greater average subsurface soil temp than sites where salamanders were absent. In Oregon, sites with salamanders had more hardwood trees, large conifers, decayed hardwood logs, sword fern, moss, leaf litter, rock, and cobble, fewer small conifers and small decayed conifer logs, greater conifer diameter, less poison oak and grass, a lower solar index and greater relative humidity than unoccupied sites.

Of the above variables, several are characteristic of late-seral forest, including high canopy cover, large tree size and presence of decayed conifer and hardwood logs. California sites with salamanders had a mean canopy cover of 80.6% (95% confidence interval, 68.0-93.3%), indicating to the authors that Siskiyou Mountains salamander in the southern portion of their range have "even less tolerance for canopy openings" than the Del Norte salamander (Ollivier et al. 2001). Canopy closure was found to be less significant for Siskiyou Mountain salamanders in Oregon, but sites with salamanders in Oregon had "a dominant canopy of large conifers," and "greater average conifer diameter." Ollivier et al. (2001) reason that larger tree size on occupied sites compared to unoccupied sites in both Oregon and California suggests a requirement for stand structures that have not been disturbed by logging, have higher canopy closure and more stable microclimates.

Greater cover of rock and cobble and lower levels of "intermixed gravel" was a significant predictor of salamander presence in both Oregon and California, demonstrating the importance of substrate to the Siskiyou Mountains salamander, which moves vertically through talus to find the appropriate microclimate.

At the microhabitat scale, sites with salamanders in California had fewer bracken ferns, greater area of leaf litter and boulder cover, and higher canopy closure and subsurface soil temperature than unoccupied sites (Ollivier et al. 2001). Sites with salamanders in Oregon had more understory hardwoods, leaf litter, sword fern, moss and rock, and less sand and soil than sites where salamanders were absent. These results largely mirror findings at coarser scales, demonstrating substrate, canopy cover, and microclimate to be important predictors of salamander presence. For example, salamanders were found to be negatively associated with bracken fern, which is a species that typically occurs in dry forest openings.

Ollivier et al. (2001) conclude their study stating:

> "Thus, we consider this salamander to be a mature to old-growth forest associated species that exists at its biological optimum under conditions found primarily in later seral stages of mixed conifer-hardwood forests in northwestern California and southwestern Oregon. It is important to use caution when interpreting correlative studies in the absence of accompanying data that demonstrate a cause and effect relationship. However, we believe that our study clearly links this

> salamander species with conditions that are found more consistently and reliably in later successional forests. This work therefore demonstrates an ecological dependence (Ruggiero et al. 1988) by the Siskiyou Mountains salamander on attributes and conditions found primarily in these mature to late seral forests."

In sum, the only systematic and comprehensive study of Siskiyou Mountains salamander habitat use supports the species dependence on mature and late successional forests for its continued survival. This is not to say that Siskiyou Mountains salamanders only occur in late-successional forests. To the contrary, on sites with deep talus on north facing slopes in wetter portions of their range, Siskiyou Mountains salamanders can be found in open areas. However, they find their optimum habitat in late-successional forests and in portions of their range are primarily limited to such forests.

9. Distinct Population Segments

The ESA provides for the listing of distinct population segments (DPS) of vertebrate species. The U.S. Fish and Wildlife Service (Fish and Wildlife) will consider a population a DPS if it is "discrete" in "relation to the remainder of the species to which it belongs" ***and*** it is "significant" to the species to which it belongs. According to Fish and Wildlife's current policy regarding recognition of distinct vertebrate populations (Federal Register V. 61, No. 26, February 7, 1996), a species is considered discrete if it is "markedly separated from other populations" because of "physical, physiological, ecological, or behavioral factors;" ***or*** it is "delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4 (a) (1) (D)." The policy further clarifies that a population need not have "absolute reproductive isolation" to be recognized as discrete. A population is considered significant based on, but not limited to, the following factors: 1) "persistence of the discrete population in an unusual or unique ecological setting;" 2) "loss of the discrete population would result in a significant gap in range;" 3) the population "represents the only surviving natural occurrence of an otherwise widespread population that was introduced;" or 4) the population "differs markedly in its genetic characteristics" (Federal Register V. 61, No. 26, February 7, 1996).

Genetic and other information suggest that populations of the Siskiyou Mountains salamander meet the U.S. Fish and Fish and Wildlife Service's criteria for consideration as distinct population segments being both discrete and significant. A combination of observed genetic differences (Pfrender and Titus 2002, DeGross 2004, Mead et al. In review) and the low vagility of the Siskiyou Mountains salamander, suggests populations in the eastern and western portion of the species range in the Klamath Watershed are reproductively isolated and thus discrete. Although populations in the Applegate Watershed in Oregon cross the Siskiyou Crest into the Klamath Watershed, genetic studies show little to no gene flow between populations (DeGross 2004, Mead et al. In review). Most populations in the Applegate watershed are in fact isolated by the Siskiyou Crest.

Observed marked genetic differences between the three populations indicate they are significant (Pfrender and Titus 2002, DeGross 2004). Pfrender and Titus (2002), for example, stated:

> "The levels of genetic variation and relationships among genetic groups indicate that *P. stormi* comprises three distinct population segments. These segments should be given independent management consideration."

And DeGross (2004) concluded:

> "Although these two groups may not be biological species these two units should receive recognition because of their ecological and evolutionary significance. Distinct differentiation of these two clades in their mtDNA and microsatellite loci warrants the designation of Evolutionary Significant Units (ESUs) (Moritz 1994)."

In particular, members of Group III *P. stormi* exhibited genetic differences that may warrant recognition as a new species (Mead et al. In review). Several genetic studies thus demonstrate three biologically significant distinct population segments of the Siskiyou Mountains salamander.

The case for significance is strengthened by information indicating differences in habitat use in California and Oregon. Siskiyou Mountains salamander populations in the southern portion of the species range are exposed to warmer and drier conditions for longer periods than those in the northern portion of the species range and thus may harbor unique behavioral and genetic adaptations that allow them to survive in a harsher environment. Ollivier et al. (2001) found that salamander sites in Oregon received more rainfall and had a longer rainy period than sites in California. These differences translated into distinct differences in vegetation and other habitat characteristics between Siskiyou Mountains salamander sites with Ollivier et al. (2001) concluding:

> "The plant assemblage and structure at the California sites are indicative of a warmer, drier climate and therefore, may be less suitable habitat for the Siskiyou Mountains salamander than the cooler, moister Oregon sites."

Moreover, these differences potentially make Siskiyou Mountains salamanders in California more sensitive to logging. Again quoting Ollivier et al. (2001):

> "The most notable difference in landscape-scale habitat models for the two versants was the addition of the years since disturbance variable in the model for the California sites. Disturbance in all instances was related to timber harvest activities, which was prevalent on both versants and occurs throughout the range of this salamander."

The best available information thus indicates that there are distinct population segments of the Siskiyou Mountains salamander. Ultimately, it is up to the U.S. Fish and Wildlife

Service whether to list individual DPS of the Siskiyou Mountains salamander. Information presented in this petition indicates the Siskiyou Mountains salamander is threatened or endangered in all or significant portion of its range. To avoid complicating recovery processes, we recommend listing the species as a whole.

10. Significant portion of range

The U.S. Fish and Wildlife Service can list the Siskiyou Mountains salamander either because it is threatened or endangered in all of its range or because it is threatened or endangered in a significant portion of its range. Populations south of the Siskiyou Crest in California are arguably more imperiled than those north of the Crest, comprised of far fewer populations and occurring in a less hospitable environment, potentially making them more vulnerable to logging (Ollivier et al. 2001, USDA, USDI Species Review Panel 2001 and 2002). In particular, the U.S. Forest Service considered Group III . *P. stormi* (*P. asupaki*) to be at risk of extirpation, regardless of management action to protect it because of the few number of populations and because of its occurrence on private and matrix lands (USDA, USDI 2004).

Pfrender and Titus (2002) considered both Group II and III *P. stormi* to be distinct because they harbored unique genetic characteristics. Genetic differences between the populations may help the species adapt to future changes in the environment, such as those expected under global climate change (see below). When considering the status of the Siskiyou Mountains salamander, the U.S. Fish and Wildlife Service should consider both California populations, either singly or combined, to constitute a significant portion of the species range.

III. LEGAL REQUIREMENTS FOR CONSIDERATION OF WHETHER THE SISKIYOU MOUNTAINS SALAMANDER MERITS LISTING AS THREATENED OR ENDANGERED

The U.S. Fish and Wildlife Service must give the benefit of the doubt to the Siskiyou Mountains salamander when faced with scientific uncertainty. The Endangered Species Act (ESA) was enacted in order to protect species faced with the threat of extinction. *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon (Babbitt)*, 515 U.S. 687, 698-99 (1995). Species protection may conflict with other policies, such as development or natural resource extraction; however Congress struck a balance in favor of imperiled species when it adopted the ESA. *TVA v. Hill*, 437 U.S. 153, 194 (1978). The act requires the government to provide protective measures to imperiled species as soon as possible. *Defenders of Wildlife v. Babbitt (Defenders of Wildlife)*, 958 F.Supp. 670, 680 (D.D.C. 1997). A precautionary approach underlies the ESA. *TVA*, 437 U.S. at 178, 194; H.R. Rep. No. 93-412, 5 (1973). Under this principle of institutionalized caution, the listing agency must list a species facing a threat of extinction even if the scientific data does not definitively and conclusively indicate that the species is threatened or endangered. *Defenders of Wildlife*, 958 F.Supp. at 680.

The ESA intends to provide protection to imperiled species before conclusive evidence indicates imminent danger of significant population declines. *Id* at 679-680. If a species is not listed because the listing agency claims the data is inconclusive, and later data shows that the species' numbers were actually fewer than initially believed, the damage done may be irreparable. An endangered species may face extinction, and an extinct species can never be brought back. This is the "precise harm[] Congress enacted the statute to avoid." *Babbitt*, 515 U.S. 687, 698 (1995). The purpose of the ESA is to "*halt* and reverse the trend toward species extinction, whatever the cost." *Id*. at 699 (quoting *TVA*, 437 U.S. at 184) (emphasis added). Delaying listing of a species certainly will not halt any downward trends, and by the time a downward trend can be conclusively confirmed with scientific data, it may be too late for mankind to ever reverse the trend. Thus, the ESA requires that the listing agency decide whether to list a species based upon the "best scientific data . . . *available.*" 16 U.S.C. § 1533(b).This means that the agency should consider the data that is "presently available." *Defenders of Wildlife*, 958 F.Supp. at 680; *Conner v. Burford*, 848 F.2d 1441, 1454 (9th Cir. 1998). It is not appropriate for the listing agency to reach "the mere conclusion that work needs to be done," nor does the ESA require any additional studies. *Northern Spotted Owl v. Lujan*, 758 F.Supp. 621, 628 (W.D. Wash. 1991); *Southwest Center for Biological Diversity v. Babbitt*, 215 F.3d 58, 60 (D.C. Cir. 2000). The listing agency may not wait to list a species until it determines that later acquired scientific data is conclusive. *Defenders of Wildlife*, 958 F.Supp. at 680. Indeed, the ESA "contains no requirement that the evidence be conclusive in order for a species to be listed." *Id.* at 679.

Congress recognized that the extinction of a species is an irreplaceable loss of incalculable value. *TVA*, 437 U.S. 153, 177-78 (1978); H.R. Rep. No. 93-412, 4 (1973). Given the significance of such a loss, Congress chose to adopt the ESA to mandate a "policy . . . [of] 'institutionalized caution.'" *TVA*, 437 U.S. at 194. "Sheer self-interest impels us to be cautious. The institutionalization of that caution lies at the heart of [the ESA bill]." *TVA*, 437 U.S. at 178 (quoting H.R. Rep. No. 93-412 at 5). The listing agency must err on the side of caution when science cannot provide a conclusive answer. Doubt as to a species' status may exist, but Congress's intent under the best available standard was to "give the benefit of the doubt to the species" when faced with any data gaps. *Conner*, 848 F.2d 1441, 1454 (9th Cir. 1998) (quoting H.R. Conf. Rep. No. 96-697, *reprinted in* 1979 U.S.C.C.A.N. 2572, 2576); *Defenders of Wildlife*, 958 F.Supp. at 680; *FWS & NMFS, Final Endangered Species Act Consultation Handbook*, I-6 (1998). When a listing decision "is a close call" the listing agency must "err on the side of the species." *Endangered Species Act Oversight; Hearing on S. 321, Before the Senate Comm. On Environment and Public Works*, 97th Cong. 37 (1982) (remarks of Senator Chafee).

The ESA's policy of institutionalized caution requires the listing agency to list as threatened a species if any of the five statutory factors, *see* 16 U.S.C. § 1533(a)(1), "are sufficiently implicated," even if a decline in species' numbers has not been conclusively established. *Southwest Center for Biological Diversity*, 215 F.3d 58, 60 (D.C. Cir. 2000). Threats from the five statutory factors can be far more indicative that a species is threatened than established population declines. *See Endangered and Threatened*

Wildlife and Plants; Re-opening of Comment Period on the Sacramento Splittail Final Rule, 67 Fed. Reg. 13095, 13095, 13097 (March 21, 2002). Certain species are inherently difficulty to survey, and fish and wildlife abundance date has an "inherent high variability." *Id*. at 13097. This may cause scientific uncertainty regarding the species' status. Nevertheless, given the "intrinsically precautionary nature of section 4," the species should be listed because the risk to the species outweighs the lack of scientifically certain data. *Id.*

Congress intended listing a species as threatened to be a "preventive measure[] *before* a species is 'conclusively' headed for extinction." *Defenders of Wildlife*, 958 F.Supp. 670, 680 (D.D.C. 1997). "The purpose of creating a separate designation for species which are 'threatened'. . . was to try to 'regulate these animals before . . .danger becomes imminent.'" *Id.* (quoting S. Rep. 93-307 at 3 (1973)). The Fish and Wildlife Service itself has indicated that "'detection of a [statistically significant] decline should not be a necessary criterion for enacting conservation measures.'" 67 Fed. Reg. At 13097 (quoting Taylor and Gerrodette (1993)). Indeed with some species, if the listing agency "'were to wait for a statistically significant decline before instituting stronger protective measures, the [species] would probably go extinct first.'" *Id.* (quoting Taylor and Gerrodette (1993)). Listing the species as threatened is critical to ensuring stronger protective measures are instituted.

IV. POPULATION STATUS

Numerous factors place the Siskiyou Mountains salamander at risk of extinction now or in the foreseeable future. These factors relate to the biology of the species and its specific habitat requirements. The Siskiyou Mountains salamander has a low reproductive rate with individuals not reaching maturity until five or six years of age, clutch sizes from 3-12, and most individuals only breeding every other year (Nussbaum 1974). This means the species has a limited ability to recover from disturbances that impact either reproduction or survival, such as loss or degradation of habitat from logging.

Siskiyou Mountain salamanders occupy a narrow habitat niche that combines aspects of regional climate, topography, stand structure, substrate and microclimate. The conditions in which *P. stormi* are able to forage on the surface are highly limited and influenced by climate variation and habitat quality with *P. stormi* in particular and salamanders in general exhibiting extreme sensitivity to habitat perturbations, including logging (e.g. Welsh 1990, Dupuis et al. 1994, deMaynadier et al. 1995, Ash 1997, Herbeck and Larsen 1999, Ollivier et al. 2001, USDA, USDI Species Review Panel 2001 and 2002). The Siskiyou Mountains salamander is thus highly susceptible to local extirpation in response to logging or other forms of habitat disturbance.

Siskiyou Mountain salamanders have the smallest range of any western *Plethodon*. Habitat is naturally fragmented across the landscape and the species' distribution in this habitat is spotty. Siskiyou Mountain salamanders have low vagility with individuals completing their life-cycle in small areas of forest and migrations between populations

and habitat occurring very rarely. In combination, these factors mean that when local populations are extirpated because of habitat disturbance, or demographic or environmental stochasticity, there is little chance habitat will be recolonized or the population rescued (Blaustein et al. 1994). This places the species at risk of range reduction and ultimately extinction.

Because of these and other factors, the Siskiyou Mountains salamander was given only a 50% likelihood of having habitat that "is of sufficient quality, distribution, and abundance to allow the species population to stabilize, well distributed across federal lands" (USDA, USDI 1994). Although the number of known sites have increased since this rating was assigned, other information indicates reason for continued concern for the Siskiyou Mountains salamanders' viability. In particular, the species has been found to be associated with late-successional forests (Ollivier et al. 2001) and genetic studies have identified three distinct population segments, each with their own set of conservation problems (Pfrender and Titus 2002, DeGross 2004, Mead et al. In review).

According to data collected by the Forest Service as part of the now defunct Survey and Manage Program, there are approximately 173 known Siskiyou Mountain salamander sites rangewide (USDA, USDI 2004). Of these, many (51 as of the 2001 species review by USDA, USDI Species Review Panel) have not been surveyed since 1994 or before and thus it is unknown if they are still extant. Sites are defined as an occurrence location entered into the Forest Service's database (ISMS) and may represent multiple records from the same population. Often the capture of an individual animal is entered into ISMS as a "site." The USDA, USDI Species Review Panel (2001) estimated that there are 6-10 population centers based on habitat contiguity and site clusters and stated that "occupied localities range in size from very small inclusions of rock to entire hillsides."

Recent genetic studies defined three distinct population segments (Pfrender and Titus 2002, DeGross 2004). Known sites are unevenly distributed among these populations with the majority (143 of 173) representing Group I *P. stormi* found in the Applegate River Watershed in Oregon. The two populations restricted to the Klamath River Watershed in California have far fewer known sites (27 for Group II and 3 for Group III) (USDA, USDI 2004). Group III *P. stormi* (*P. asupaki*) found in the southeastern portion of the species range is of particular concern because it exhibited the widest divergence from other populations, has the fewest number of known sites, and much of its known range and sites are found on private or matrix lands, which are managed for intensive harvest. USDA, USDI (2001 Species Review Panel and 2004) considered this population to have the greatest risk of extirpation.

Because Siskiyou Mountain salamanders spend considerable amounts of time underground and have a highly patchy distribution, abundance at both local and landscape scales is difficult to estimate. Populations likely range in size from a few individuals to thousands of individuals in some cases (Nussbaum 1974, Welsh and Lind 1992). Based on numbers of salamanders captured on three 60 m^2 plots, Nussbaum (1974) guessed that in optimum habitat Siskiyou Mountain salamanders may reach a density of 0.53 salamanders/m^2. This figure was not based on marked individuals and

thus no confidence intervals or estimate of standard error were provided. Nussbaum (1974) than used this estimate of density to extrapolate total Siskiyou Mountain salamander abundance rangewide, based on the species known range at the time and a guess that 3% of the species range may be suitable habitat. In total, Nussbaum guessed there may be more than 3,000,000 Siskiyou Mountain salamanders. This sounds like a large number of salamanders, but there are several important factors to consider. First, Nussbaum (1974) prefaced his estimates with the following statement:

> "As stated above, it is impossible to know the carrying capacity of the entire range of *P. stormi*, and hence estimates of current or realized densities are of limited value. Furthermore, it is nearly as impossible to estimate the total abundance of such a small secretive animal as P. stormi. Density estimates for single small populations are possible with considerable expenditure of time; but because of limited time, I opted to concentrate more on range determination than on density estimates for a few local areas. However, if certain assumptions are made, crude estimates of abundance are possible, and at great risk of personal ridicule, I will attempt such estimates."

Because of the compounding error from estimating density, amount of suitable habitat, and finally amount of occupied habitat, little stock can be placed in the above abundance estimate, as readily admitted by the author.

Nevertheless, in optimum habitat *P. stormi* can be abundant. Using more reliable methods including mark and recapture of animals and the Lincoln-Peterson estimator, Welsh and Lind (1992) estimated that in optimum habitat, which produced the greatest capture rate in a metapopulation study, the closely related *P. elongatus* had a mean density of 0.9 (0.3 SE) salamanders/m^2 and an estimated abundance for the entire 4500 m^2 study area of 4034.7 salamanders (1382 SE). The authors, however, caution that their study area is likely the exception rather than the rule. Based in part on results from a separate study that captured salamanders from across the range of *P. elongatus*, the authors conclude:

> "This species can occur at high local abundance, but such sites appear to be the exception, and probably represent 'hot spots' or potential source populations deserving of special protection. The site with the highest capture rate from the metapopulation study yielded 30 captures in 49 m^2; the next highest site yielded 13 captures/49 m^2, and most sites produced one to five animals/49 m^2" (Welsh and Lind 1992).[1]

P. elongatus has similar habitat requirements and a similar patchy distribution as *P. stormi*, although a larger range, and thus it is likely safe to assume that large populations of the Siskiyou Mountains salamander such as those observed by Nussbaum (1974) in optimum habitat, are rare. This conclusion provides further reason for skepticism about rangewide estimates of abundance.

[1] The authors used the site with the highest capture rate from the metapopulation study in the study cited here.

It is important to note that crude rules of thumb for minimum viable population size, such as those proposed by Gilpin and Soule (1986) and others for long-term persistence, don't apply to populations that can be extirpated by catastrophic disturbance. Probability of persistence is independent of population size if the population can be eliminated in a single event. It doesn't matter if there are 500 or 5,000 salamanders on a hillside if a large fire or logging destroys the entire habitat and indeed numerous studies have documented complete elimination of salamander populations by logging (multiple refs and see below). Nussbaum (1974) reached much the same conclusion:

> "If a species of salamander totaled 10,000 individuals, this may at first thought seem like a lot, but one fairly large talus slope of optimal quality habitat could conceivably contain 10,000 individuals and hence the entire species. In this hypothetical case the fate of one talus slope could determine the fate of the species."

Probability of persistence in the Siskiyou Mountains salamander is thus determined less by overall abundance than it is by numbers of populations and the security of the habitat where those populations are found.

V. PRESENT AND THREATENED DESTRUCTION, MODIFICATION, OR CURTAILMENT OF THE SISKIYOU MOUNTAINS SALAMANDER'S HABITAT AND RANGE

Logging is the primary threat to the habitat of the Siskiyou Mountains salamander. Siskiyou Mountains salamanders and other *Plethodons* breathe through their skin. Because this exposes them to water loss and desiccation, Plethodons are only active on the surface for short periods of the year when moisture conditions are suitable (Feder 1983). The majority of foraging and reproductive activities take place during these short forays. Removal of the canopy and disruption of the surface layer from logging or other disturbances alters stand microclimate. Chen et al. (1993), for example found that the interior of old-growth Douglas-fir stands was cooler and moister than forest edges or clearcuts. Such changes can result in conditions unsuitable for surface activity and the loss or sharp decline in salamander populations, particularly for a species such as the Siskiyou Mountains salamander that occurs in a region with a relatively warm, dry climate (see references below). Replicated studies examining the effects of logging or other disturbances on the Siskiyou Mountains salamander have not been conducted. Several lines of evidence, however, demonstrate logging harms the species' habitat and populations, including information about the species habitat needs, observational data, and studies of closely related species.

Recent research demonstrates the Siskiyou Mountains salamander is closely associated with old-growth forests, typically with very high canopy closure (Ollivier et al. 2001). In California, sites with Siskiyou Mountains salamander had "a narrow and relatively high confidence interval for mean canopy closure (68.0-93.3%)" (Ollivier et al. 2001). The forest canopy conserves surface moisture and helps to maintain a high relative humidity

for periods of surface activity. Multi-layered canopies maintain a suitable climate (Chen et al. 1993). Removal of forest canopy may result in the death, by desiccation, to residing salamanders (Nussbaum 1974, Welsh and Ollivier 1995). These results strongly suggest that *P. stormi* is sensitive to canopy removal either in whole from clearcutting, or in part from thinning. Welsh and Ollivier (1995) also believe tractor logging may harm Siskiyou Mountains salamanders by compacting, breaking and realigning talus used for thermal regulation and foraging cover.

Although a replicated pre and post logging study of the Siskiyou Mountains salamander has not been conducted, Clayton sampled a high-graded site near Hutton Guard Station and a clearcut site just above the Station from 1992-1994 (see Welsh and Ollivier 1995 attached to this petition). Salamander numbers were consistent in the high-graded site 1992-1994. In the clearcut, salamanders were abundant immediately following cutting in April 1993, but appeared to have been eliminated from the site by April 1994. Surveys in 1995 and 1998 similarly failed to find salamanders (CDFG 2004). A single salamander was found in 1999 and several were found on the site in 2003 (CDFG 2004), suggesting some salamanders may have moved back onto the site from adjacent habitat. It is unknown whether they have returned to their former abundance prior to cutting. These results suggest that Siskiyou Mountains salamanders are eliminated by overstory removal and may return as habitat recovers if there is adjacent habitat.

Studies from across North America demonstrate logging harms salamander populations and *Plethodontids* in particular (see Dupuis et al. 1994, deMaynadier and Hunter 1998, Ash 1997, Herbeck and Larsen 1999). deMaynadier and Hunter (1995), for example, reviewed 18 studies and found median abundance of amphibians was 3.5 times greater on controls over cleacuts. Specific to the Pacific Northwest, a number of studies documented greater salamander abundance in old-growth compared to clearcuts or second growth (e.g. Bury and Corn 1988, Raphael 1988, Welsh and Lind 1988 and 1991, Welsh 1990, Corn and Bury 1991, Dupuis et al. 1994). Of these studies, those that studied species most closely related to the Siskiyou Mountains salamander and species in similar climactic settings consistently found logging to negatively affect salamander populations.

Using a variety of sampling techniques, Raphael (1988) sampled 166 sites, representing clearcuts through old-growth in northwestern California. Three salamander species were found to be closely associated with late seral forests, including the closely related Del Norte salamander (*P. elongatus*). No salamanders were associated with early seral forests (Raphael 1988). Welsh and Lind (1988) used pitfall traps and time constrained searches in stands ranging from 40-450 years old in southwestern Oregon and northwestern California to measure differences in herpetofauna, concluding that:

> "Amphibians were significantly more abundant in old than in young stands and significantly less abundant in dry than in moist stands. Our research indicates that changes in forest structure due to forest practices results in reduced species diversity and abundance among the herpetofauna."

Similar to Raphael (1988), the Del Norte salamander was one of the species that was more abundant in old forest compared to young (Welsh and Lind 1988). Similarly, Welsh (1990) and Welsh and Lind (1995) found the Del Norte salamander to be more abundant in old-growth stands compared to young or mid-seral forest. Welsh (1990) concluded:

> "During this study, 91 percent of 406 Del Norte salamanders were found on old-growth forest sites. The remaining salamanders were from two mature sites, or from two young sites both adjacent to older forest."

In contrast, Diller and Wallace (1994) found *P. elongatus* to be common in managed young stands in northwestern California. The authors of both studies, however, agree that differences in their findings relate to differences in prevailing climate in the study areas. Areas surveyed by Diller and Wallace (1994) have a milder, wetter climate due to proximity to the coast, whereas areas surveyed by Welsh and Lind (1995) are dryer, hotter and more interior, similar to areas where the Siskiyou Mountains salamander are found.

Dupuis et al. (1994) found that clearcutting reduced *Plethodon vehiculum* abundance by 70% and that the species was six times more abundant in old-growth than in managed stands, concluding that:

> "In summary, old-growth forests support more salamanders than second growth managed stands, particularly young stands. These findings agree with other surveys conducted in the Pacific Northwest and in eastern North America."

Grialou et al. (2000) found that Dunn's salamander (*Plethodon dunni*) was found in both clearcuts and forested areas, including gravid females. Although in the same genus as Siskiyou Mountains salamander, Dunn's salamander has very different habitat requirements being primarily a stream bank/splash zone inhabitant, and thus results from this study cannot be applied to *P. stormi*. This example and the results overall show that many species of salamander are sensitive to disturbance for logging, but that the results are species and range specific. Notably, all of the studies that considered species closely related to the Siskiyou Mountains salamander and species occurring in similar habitat found them highly sensitive to logging. This was particularly well documented for the Del Norte salamander in dryer portions of its range (Raphael 1988, Welsh 1990, Welsh and Lind 1988 and 1991). In combination with information indicating that Siskiyou Mountains salamanders require old-growth habitats across much of their range (Ollivier et al. 2001), this information indicates the species is highly sensitive to logging.

The extent of logging in Siskiyou Mountains salamander habitat has not been quantified. It is likely, however, that the species has experienced substantial habitat loss. USDA, USDI Species Review Panel (2001), for example, stated that "cumulative effects from past harvest have impacted populations on federal lands" and noted that 10% of potential habitat on the Applegate Ranger District was clearcut between 1980-1990.

Habitat loss has likely been more severe on private lands, where there are fewer restrictions on logging. In particular, Group III *P. stormi* have been identified as occurring in an area of private lands with extensive past and ongoing logging (USDA, USDI Species Review Panel 2001). USDA, USDI Species Review Panel (2001) concluded: "Private lands (20%) within the range of the species are not expected to provide much, if any, suitable habitat for the species.

On federal lands, the Siskiyou Mountains salamander has been protected by the Survey and Manage Program of the Northwest Forest Plan since 1994, which required pre-disturbance surveys for the species and establishment of protected buffers where the species was found. This provided substantial protection for the species. For example, a biological evaluation for the Carberry Creek Timber Sale on the Rogue River National Forest concluded that because of mitigations provided by the Survey and Manage Program, the timber sale would have no effect on the Siskiyou Mountains salamander:

> "This species is known to occur at various locations within or near the proposed activities and potential habitat occurs within most of these areas. Surveys will be conducted before any activities begin including road construction or reconstruction, logging, or burning. Under the action alternatives, no treatments would take place in known salamander habitat and all known habitat will receive a 100' buffer around the outer periphery and no overstory trees will be removed within this buffer. If these mitigation measures are followed, the proposed action should have no effect on Siskiyou Mountains salamander or their habitat" (USFS 1997).

Similar conclusions have been reached for numerous other timber sales within the range of the Siskiyou Mountains salamander. In March 2004, the Bush Administration eliminated this program entirely, leaving the Siskiyou Mountains salamander with little to no protection from logging. Even with the Survey and Manage Program in place, USDA, USDI Species Review Panel (2001) concluded:

> "Suitable habitat within Matrix (12%) and AMA (29%) lands are expected to decrease in the immediate future, reducing the potential for these lands to provide suitable habitat for the species."

Without the Survey and Manage Program and the mitigations it provides, it is clear that timber sales planned in the future will harm the Siskiyou Mountains salamander by allowing the destruction and modification of Siskiyou Mountains salamander habitat. Northwest Forest Plan Standards and Guidelines allow logging that removes substantial portions of the canopy, failing to establish minimum canopy levels, and indeed a number of sales that have been cut in the Siskiyou Mountains salamander's range reduced canopy closure well below levels required by the species, including the Carberry, Wagner Gap and many others. These sales did little direct harm to Siskiyou Mountain salamander populations only because the Survey and Manage Program kept them out of areas where the salamanders were found. Such protection is no longer present.

Other actions have resulted and will continue to result in loss of Siskiyou Mountains salamander habitat, including road construction, mining and recreational development. USDA, USDI Species Review Panel (2001), for example, conclude:

> "Timber harvest is perceived to be the primary threat to the species, but road building, quarry development, and recreational developments are also known to impact the species."

A study by deMaynadier and Hunter (2000) found that salamander abundance was 2.3 times higher at forest control sites than at roadside sites. Furthermore, captures in roadside traps (road crossings) were approximately 26 percent of similarly oriented captures in paired forested controls. *Plethodontids*, as species where natal dispersal and migratory movements are limited, were found to be particularly sensitive to population fragmentation by logging roads. In addition, the total area of land converted to road surface and shoulder clearance for permanent logging roads represents a significant loss of former habitat in densely roaded regions (deMaynadier and Hunter 2000). deMaynadier and Hunter (2000) conducted their study in Maine and thus focused on other *Plethodon* salamanders. Further observations of *P. stormi* need to be made to determine their specific ability to cross roads and more generally to disperse between habitats and populations. In the interim, a conservative approach is to assume that roads do lead to population fragmentation.

VI. OTHER NATURAL OR MANMADE THREATS TO THE CONTINUED EXISTENCE OF THE SISKIYOU MOUNTAINS SALAMANDER

1. Fire

Fire is a natural part of the ecosystem in the range of the Siskiyou Mountains salamander (Agee 1993) and the species has survived for eons in the presence of periodic fire. In recent decades, however, fire suppression has led to increased fuel loadings in some, but certainly not all, forest stands, resulting in a change from a low to high intensity fire regime (e.g. Agee 1991). Neither the Siskiyou Mountains salamander's response to fire nor the current fire danger in the species' habitat have received substantial study. To the extent that fire has the potential to remove or reduce forest canopy cover in Siskiyou Mountains salamander habitat, there is some risk that future fires will impact populations. Combined with habitat loss from logging, this could pose a risk to the species.

Risk of stand destroying fires in the range of the Siskiyou Mountains salamander has likely increased as a result of intensive forest management that focuses on the largest most fire resistant trees and creates of young, highly combustible plantations. The number and distribution of plantations resulting from industrial timber management likely has altered fire regimes at both stand and landscape scales (Frost & Sweeny 2000). Perry (1995) suggested that once a threshold proportion of highly combustible even-age patches are established on a forest landscape, the potential exists for a self-reinforcing cycle of catastrophic fires. A study of the 1987 Klamath complex fires affirmed the susceptibility of plantations to high severity fire. Odion et al. (In press) found that young

(>20 year-old) tree plantations experienced "much higher severity fire" effects than closed canopy forests. More than 50 percent of high severity fire effects occurred in plantations, even though tree farms only comprised 17 percent of the burned landscape. In contrast, closed canopy, mature forests mostly experienced low and moderate severity effects (up to 13 percent high severity). Most of the older, closed canopy forests in the study area had not burned since before 1911, when managers first began recording fires.

2. Climate change

Olliver et al. (2001) documented the importance of regional climate, in particular variation in average precipitation, on the distribution and habitat selection of the Siskiyou Mountains salamander. The unique physiology of *Plethodon* salamanders, including *P. stormi*, make them particularly sensitive to variations in climate (Feder 1983, Ollivier et al. 2001). It seems safe to assume that if spatial variation in climate substantially influences Siskiyou Mountains salamander that temporal variation is also likely to influence their distribution and ability to find suitable habitat. Current projections for global climate estimate the next 50 years will see a 1.5-6.0°C rise in temperature (see IPCC 2001). Temperatures in western North America are expected to rise at a greater rate than the global average, and there is uncertainty about whether these rises will be accompanied by greater or lesser precipitation (see IPCC 2001). These changes could be devastating for the Siskiyou Mountains salamander and other species. Warmer temperatures may result in greater forest fires and the loss of forest canopy to the detriment of the salamander's habitat. They may also shorten the window in which the species is able to forage and reproduce. Unlike more vagile species, it is unlikely the Siskiyou Mountains salamander will simply be able to shift its range in response to rapid climate change. An increasing consensus has developed that we are and will continue to experience global warming. Such warming may have disastrous impacts on the Siskiyou Mountains salamander and further necessitates protection of the species under the ESA, including all three distinct population segments, one of which may prove better adapted to the changing conditions under global warming.

VII. INADEQUACY OF EXISTING REGULATORY MECHANISMS

1. Federal lands

Approximately 80% of the Siskiyou Mountains salamander's range occurs on federal lands divided between the Rogue River and Klamath National Forests and Medford District of the BLM (USDA, USDI Species Review Panel 2001). Of 161 sites in ISMS, 39 (24%) are found in congressionally withdrawn areas or late-successional reserve and are expected to receive adequate protection. Of the known range, 39% is within protected land designations. Of suspected high quality habitat, however, less than 10 percent is in reserves (Clayton et al. 2002 as cited in USDA, USDI 2004). Thus, 76% of known sites and as much as 90% of suspected high quality habitat occurs on non-protected land allocations available for timber harvest and other activities. USDA, USDI Species Review Panel (2001) concluded:

> "It is likely that non-protected land allocations will be required in order to ensure persistence for the species, both in the northern and southern portions of the range."

The Siskiyou Mountains salamander formerly received substantial protection from the Survey and Manage Program, which required the Forest Service and BLM to survey for Siskiyou Mountain salamanders and where found to create protected buffers. Siskiyou Mountains salamander populations in Oregon were exempted from pre-disturbance surveys after 2002, but maintained in the Survey and Manage Program. In 2004, the Bush Administration scrapped the Survey and Manage Program entirely. In analyzing the effects of removing the Survey and Manage Program, USDA, USDI (2004) summarized the status of the Siskiyou Mountains salamander as follows:

> "The Siskiyou Mountains salamander did not meet the Survey and Manage persistence criterion to maintain stable, well-distributed populations from implementation of other elements of the Northwest Forest Plan (e.g., land allocations, down wood). In the north, most of the federal range occurs within an Adaptive Management Area, where programmed timber harvest activities can occur. Less than 10 percent of the high quality habitat is in reserves and much of this range is suitable habitat for the species (Clayton et al. 2002). In the south, the animal is patchier in distribution, with fewer sites. Also, a new genetic population has been identified (from three sites, Scott Bar group), so maintenance of distinct populations is important."

This indicates that careful management is needed to ensure persistence of the Siskiyou Mountains salamander in all or significant portions of its range, which given findings of Pfrender and Titus (2002) and Mead et al. (In review), is necessary to maintain the genetic diversity of the species. Despite the need for caution, the Bush Administration selected Alternative 2 described in USDA, USDI (2004), which eliminates the Survey and Manage Program. USDA, USDI (2004) predict that elimination of the Survey and Manage Program will result in gaps in the Siskiyou Mountains salamander's range in both the north and south, and that regardless of management, Group III *P. stormi* (referred to as the Scott Bar population) is at risk of extirpation:

> "Northern and southern groups of the Siskiyou Mountains salamander would have habitat (including known sites) sufficient to support stable populations range-wide, with potential gaps, in the Northwest Forest Plan area under Alternative 2 (and Alternative 3 for the northern population); however, in the south, where the Scott Bar population is known from only three sites, habitat (including known sites) is insufficient to support stable populations in the Northwest Forest Plan area due to stochastic events."

Gaps in the salamander's range created by logging compromises the species' viability by fragmenting populations, making it unlikely that habitat will be recolonized following anthropogenic or stochastic disturbance. This places the species as a whole at risk of extinction now or in the foreseeable future.

USDA, USDI (2004) propose to mitigate loss of the Survey and Manage Program by encouraging the various management units of the Forest Service and BLM to place species on their sensitive species lists. The sensitive species programs of the Forest Service and BLM, however, will provide substantially less protection for the Siskiyou Mountains salamander, failing to require surveys and making mitigation optional. USDA, USDI (2004) essentially admit this, stating:

> "Under Alternative 2 (and Alternative 3 for the northern population), the Siskiyou Mountains salamander is assumed to be included in the Special Status Species Program as Forest Service Sensitive in Oregon and Region 5, and Bureau Sensitive in Oregon. Discretion in survey methodology and in the management of known sites under the Special Status Species Programs results in uncertainty whether all sites would be detected and managed. Lack of detection and subsequent losses of highly-localized populations or subpopulations are possible, especially in the southern portion of the species range where multiple genetic lineages have been detected. This, in turn, creates some uncertainty in the analysis of environmental consequences because the inadvertent loss of undetected sites may affect the maintenance of stable, well-distributed populations, particularly in the southern range. Some gaps in the species distribution may result." (USDA, USDI 2004).

For a petition to list the California spotted owl, a Forest Service sensitive species, we reviewed 505 biological evaluations in which the Forest Service concluded a project may affect individual California spotted owls (Greenwald 2000). This analysis revealed a number of short-comings in the Forest Service's implementation of the sensitive species program. First, our analysis revealed that the Forest Service does not routinely conduct project specific surveys and instead relies on information from past surveys or research projects. Second, the Forest Service does not track cumulative effects on habitat or individuals of a species by keeping a record of the number of projects approved in a given habitat area or by specifically identifying species or habitat locations in biological evaluations. Finally, the Forest Service does not routinely include mitigation above what is required by their Forest Plans as part of their evaluation of project effects on a species (Greenwald et al. 2000). These results indicate that listing the Siskiyou Mountains salamander as a sensitive species will not result in the routine survey for the species or protection of its habitat from logging.

In the absence of the Survey and Manage Program, management of the Siskiyou Mountains salamander is governed by standards and guidelines under the Northwest Forest Plan for Matrix and the Applegate Management Area (AMA). Seventy eight percent of known sites and 45% of the known range of the species occur north of the Siskiyou Crest, where most federal land and 78% of known sites are in the Applegate AMA.

AMAs were created by the Northwest Forest Plan "to encourage the development and testing of technical and social approaches to achieving desired ecological, economic, and

other social objectives" (USDA, USDI 1994). AMAs are afforded more management latitude than other land designations under the Northwest Forest Plan. Protections for late-successional reserves and Congressionally withdrawn areas found within the boundaries of AMAs must be followed, but otherwise there are no standards and guidelines for AMAs. Minimum standards for green-tree, snag and coarse-woody debris retention for Matrix lands do not have to be observed in AMAs, although in practice the Applegate AMA generally does follow retention standards prescribed in the Matrix (B. Bell personal communication).

The Applegate AMA is 277,500 acres and was established for "development and testing of forest management practices, including partial cutting, prescribed burning, and low impact approaches to forest harvest (e.g., aerial systems) that provide for a broad range of forest values, including late-successional forest and high quality riparian habitat" (USDA, USDI 1994). According to the Northwest Forest Plan, each AMA was supposed to develop a plan. Rather than producing a plan, however, the Applegate AMA produced a "Guide," stating:

> "Why, then, are we writing a 'guide,' rather than a 'plan'? An agency plan usually contains decisions regarding allocation of lands or resources to specific uses and (or) specific standards and guidelines required. However, due to the complexity of multiple jurisdictions and resource issues as well as social and institutional capacity, an adaptive management area wide integrated plan in not yet possible." (USDA, USDI 1998)

As such, the Applegate AMA "Guide" does not qualify as a regulation that should be considered under the adequacy of existing regulations. It contains no discussion of the Siskiyou Mountains salamander and includes no specific regulations to protect the species or its habitat.

Given that the "Guide" does not provide any protection for the Siskiyou Mountains salamander, the only protections that marginally apply in the AMA and on other Federal lands outside reserves are those for the Matrix, including standards for retention of green trees and snags, coarse woody debris and remnant old-growth stands. The Northwest Forest Plan requires that green trees should be maintained on a minimum of 15% of the area in any cutting unit with >70% of it aggregated in clumps >2.5 acres, that sufficient snags should be retained to maintain cavity nesting bird populations at 40% of potential, and that at least 240 linear feet of logs >20" diameter should be retained on the forest floor. The Plan also requires that where late-successional forests occupy less than 15% of any watershed, all remaining stands should be retained (USDA, USDI 1994). To the extent that these Guidelines protect clumps of trees or remnant stands of old-growth that harbor Siskiyou Mountains salamander, they could provide some protection for the species. However, since surveys will no longer be required for the species this will only occur accidentally.

Overall, the standards fail to protect the specific habitat attributes of Siskiyou Mountains salamander, failing to provide protection for talus slopes or the high canopy cover

required by the species. They lack restrictions on tractor logging in talus, which destroys suitable habitat, or to require retention of minimum canopy levels. Lack of survey for the species or standards to specifically protect the salamander's habitat mean the standards and guidelines fail to provide substantial protection for the Siskiyou Mountains salamander. In sum, removal of the Survey and Manage Program leaves the Siskiyou Mountains salamander with little to no protection on Federal lands, which comprises the majority of the species' range.

2. State Regulations

The Siskiyou Mountains salamander is listed as a vulnerable species by the Oregon Department of Fish and Wildlife. This designation does not provide any regulatory protection for the species. In California, the species is listed as threatened under the state Endangered Species Act, which does include substantial protections for the species. For all Timber Harvest Plans (THPs) in the range of the Siskiyou Mountains salamander, timber companies have to consult with California Department of Fish and Game (DFG) to ensure they don't take the species. DFG considers all areas with talus covering 25% of the area to be suitable habitat. To proceed with logging, timber operators must either conduct protocol surveys that determine the species isn't present, obtain an incidental take permit, or protect all suitable habitat from logging, including limiting logging in 50-100' buffers around suitable habitat to periods when the species is not active. These requirements provide substantial protection for the species on the minority portion of its range on private lands in California. Unfortunately, DFG is in the process of recommending the Siskiyou Mountains salamander be taken off the state threatened species list because the protections are perceived to be overly burdensome (California Department of Fish and Game 2004). As such, protections provided by California's ESA are uncertain and should not be considered to provide firm regulatory protection for the species. No other protections are afforded the Siskiyou Mountains salamander on state or private lands.

VIII. DESIGNATION OF CRITICAL HABITAT

Petitioners request and strongly recommend the designation of critical habitat for the Siskiyou Mountains salamander coincident with its listing. Because the distribution of the primary constituent elements of the salamander's critical habitat, namely suitable substrates in combination with landscape and stand features necessary to support the species, is poorly defined, critical habitat should be designated in the entire range of the species. The primary threat to the Siskiyou Mountains salamander is habitat destruction and thus critical habitat will provide a clear and measurable benefit for the species.

IX. CONCLUSION

The Siskiyou Mountains salamander is one of many unique species found only in the Klamath-Siskiyou Region. It has a narrow and fragmented range and is primarily limited to late-successional forests with appropriate substrate. Logging is a substantial threat to its continued existence, particularly following removal by the Bush Administration of

protections provided by the Survey and Manage Program of the Northwest Forest Plan. Unlike many imperiled species that are threatened by a combination of habitat loss, invasive species and other factors, the Siskiyou Mountains salamander is almost singly threatened by destruction of habitat. As such, protection of its habitat through listing and designation of critical habitat is highly likely to ensure the continued existence of the species.

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