Species Status Assessment Report for the Relictual Slender Salamander (*Batrachoseps relictus*), Kern Canyon Slender Salamander (*Batrachoseps simatus*), and Kern Plateau Salamander (*Batrachoseps robustus*)

Photos (clockwise from upper left): Relictual slender salamander (Noah Morales), Kern Canyon slender salamander (Will Flaxington), and Kern Plateau salamander (Will Flaxington).

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Sacramento Fish and Wildlife Office

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Executive Summary

Petition History

On July 11, 2012, the Center for Biological Diversity (CBD 2012, entire) submitted a petition to list 53 species of reptiles and amphibians including the relictual slender salamander (*Batrachoseps relictus*), Kern Canyon slender salamander (*Batrachoseps simatus*), and Kern Plateau salamander (*Batrachoseps robustus*) as threatened or endangered species under the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531–1543). On July 1, 2015, we (the U.S. Fish and Wildlife Service) published in the Federal Register a 90-day finding for the relictual slender salamander and the Kern Canyon slender salamander (80 FR 37568–37579, July 1, 2015), and on September 18, 2015, we published a 90-day finding for the Kern Plateau salamander (80 FR 56423–56432, September 18, 2015). We found that the petition presented substantial scientific and commercial information that the listing of the relictual slender salamander, Kern Canyon slender salamander, and the Kern Plateau salamander may be warranted under the Act. As a result, we prepared this Species Status Assessment (SSA) Report to provide the scientific foundation for determining if the three salamander species (three slender salamanders: 3SS) are warranted for listing under the Act. The SSA Report will inform our 12-month finding under section 4(b)(3)(B) of the Act, in which we will determine whether listing is warranted.

Species Biology

The 3SS are terrestrial salamanders in the family Plethodontidae. They depend on skin and buccopharyngeal respiration (oxygen is taken up simply by diffusion across moist membranes or by the contraction and relaxation of the muscles of the cheeks or mouth and throat) and are therefore highly susceptible to cutaneous water loss and desiccation. The salamanders are within the *Batrachoseps* genus of slender salamanders and have characteristically narrow, long, and slim bodies. Slender salamanders are highly sedentary and have high site fidelity. The 3SS are restricted to historically small ranges that are almost completely within Sequoia National Forest in the southern Sierra Nevada. Within their ranges the 3SS are found in small patches of moist habitat. Little information is available on the life history and ecology of these species. The salamanders are thought to have seasonally restricted surface activity, sheltering in underground burrows during unfavorable conditions. At low elevations the salamanders are active on the surface during the winter and early spring, while at high elevations the salamanders are active in the late spring and summer. When the salamanders are active on the surface, they seek shelter under cover objects such as woody debris, leaf litter, or rocks within moist microhabitat near seeps, springs, streams, and rivers.

Methodology

There is a paucity of information on the species-specific biology, abundance, and distribution of the 3SS. Widespread systematic surveys have not been carried out for the species. Therefore, the best available information on the 3SS comes from recorded observations of individuals found during opportunistic searches over limited areas. Some of the sites where

salamanders have been observed have not been searched for the species in the last 30–40 years. In the absence of more recent information, we assume the species continue to occupy these sites. Additionally, there is no available information on population structure or population size of the 3SS. Therefore, in the SSA Report we divide the known sites of each species into distinct geographic groups to aid our analysis of the status of the species.

To assess the viability of the 3SS in the SSA Report, we use the three conservation biology principles of resiliency, redundancy, and representation (3Rs). These principles rely on assessing the species at the individual, population, and species level in order to determine whether the species can maintain its persistence into the future and avoid extinction by having multiple resilient populations distributed widely across its range. In the absence of information on the population structure and size of the 3SS, the resiliency of the geographic groups is analyzed by assessing the threats to habitat and individuals within each geographic group. When possible, we also assess the condition of the individual needs, bodies of surface water such as seeps, springs, and streams; cover objects including woody debris, bark, leaf litter, and rocks that provide refugia within riparian and aquatic habitats; cool and damp microhabitat conditions; and small invertebrate prey, and the condition of the population needs, survival, dispersal, fecundity, and abundance, in our analysis of the resiliency of geographic groups. In the SSA Report, we evaluate redundancy at the species level by considering the number and distribution of occupied sites in relation to the scale of catastrophic events that are likely to occur such as fires. In the absence of genetic data for these species, the breadth of environmental diversity and the ecological setting of the species are used to assess representation at the species level.

Species Overview

The relictual slender salamander is known historically from 13 sites in the southern Sierra Nevada within Sequoia National Forest. The relictual slender salamander has the smallest range of all known slender salamanders. The species is found in close association to creek margins and seeps with limited tree cover of oaks (*Quercus* spp.), buckeyes (*Aesculus* spp.), sycamores (*Platanus racemosa*), pines (*Pinus* spp.), and firs (*Abies* spp.). To aid our analysis in the SSA Report, we separated the known sites of the relictual slender salamander into three geographic groups including the Lower Kern River Canyon Geographic Group, the Lucas Creek Geographic Group, and the Squirrel Meadow Geographic Group. The relictual slender salamander is thought to be extirpated from all sites within the Lower Kern River Canyon, leaving eight extant sites of the relictual slender salamander within approximately 8 kilometers (km; 5.0 miles (mi)) on Breckenridge Mountain.

The Kern Canyon slender salamander is known historically from 18 sites south of Lake Isabella in the Lower Kern River Canyon, Piute Mountains, and along Erskine and Bodfish Creeks. To aid in analysis of the Kern Canyon slender salamander in the SSA Report, we divide the known sites of the species into two geographic groups: the Lower Kern River Canyon Geographic Group and the Erskine Creek Canyon Geographic Group, which includes sites along Erskine and Bodfish Creeks and in the Piute Mountains. Within these geographic groups, the species is found within wet margins of creeks and seeps in narrow canyons shaded with willows

(*Salix* spp.), cottonwoods (*Populus* spp.), oaks (*Quercus* spp.), and pines (*Pinus* spp.). The Kern Canyon slender salamander has also been found on talus slopes and in open grasslands. The sites occupied by species in the Lower Kern River Canyon Geographic Group are within Sequoia National Forest, and the sites in the Erskine Creek Canyon Geographic Group are at higher elevations outside of Sequoia National Forest. The Kern Canyon slender salamander is listed as threatened under the California Endangered Species Act (14 California Code of Regulations § 670.5, June 27, 1971).

The Kern Plateau salamander is known from 35 sites. Within Sequoia National Forest, the Kern Plateau salamander occupies sites on the Kern Plateau and in the Scodie Mountains. The Kern Plateau salamander also occupies sites on the eastern slope of the Sierra Nevada including areas within Inyo National Forest, Owens Valley, and Indian Wells Valley. On the Kern Plateau, Kern Plateau salamanders are found under woody debris and leaf litter in mesic pine-fir forests (*Pinus* spp. - *Abies* spp.). In the Scodie Mountains and on the eastern slope of the Sierra Nevada, Kern Plateau salamanders are found in rocky areas within the wet margins of seeps, perennial springs, and streams in otherwise dry habitat. To aid our analysis in the SSA Report, we designated the known sites of the Kern Plateau salamander into three geographic groups: Kern Plateau, Scodie Mountain, and Inyo Geographic Groups.

Influences to Viability

Our analysis of the past, current, and future factors influencing viability of the 3SS revealed several threats that may pose a risk to the future viability of the species. These include habitat degradation associated with road construction, recreation, grazing, timber harvest, hazard tree removal, infrastructure development, fire, and climate change. Potential threats include collection and introduction of disease such as chytridiomycosis. Historically, infrastructure development and road construction have had the greatest impact on the habitat of the 3SS. The threats of climate change and fire are growing in magnitude and are thought to be the primary threats to the future viability of the 3SS.

Current Condition

Our analysis of the current condition of the 3SS considers the past and current threats to each species. When possible, we also assess the condition of the individual and population needs of the species. The paucity of recent information on the species contributes to uncertainty in our analysis of the current condition of the 3SS.

The relictual slender salamander has persisted historically within a small range. A combination of threats has contributed to the current condition of the relictual slender salamander including road construction and maintenance, recreation, grazing, timber harvest, hazard tree removal, fire, and climate change. Under the current condition, the relictual slender salamander occupies only part of the species' historical range as the species is extirpated from sites within the Lower Kern River Canyon. Regarding redundancy, the ability of the species to withstand catastrophic events, we note the relictual slender salamander has been reduced to eight remaining occupied sites that are within 8.0 km (5.0 mi) of each other. In comparison to the scale of catastrophic events that are likely to occur such as large fires burning at high severity, the relictual slender salamander has limited redundancy under the current condition. In terms of representation, the relictual slender salamander currently exists in a limited ecological setting as the extant sites are within similar habitat at mid to high elevations (1,219–1,920 m (4,000–6,300 ft)) on Breckenridge Mountain and the species no longer occupies habitat at lower elevations.

Under the current condition, the resiliency of the Kern Canyon slender salamander geographic groups is thought to be reduced from historical conditions due to a combination of threats including road construction and maintenance, recreation, grazing, infrastructure development, fire, and climate change. The Kern Canyon slender salamander may be largely or entirely extirpated from the nine westernmost sites in the Lower Kern River Canyon Geographic Group. Therefore, the redundancy of the Kern Canyon slender salamander is likely reduced from historical conditions, and the redundancy of the species is limited in comparison to catastrophic events that are likely to occur such as fires. In terms of representation, the Kern Canyon slender salamander exists in a reduced ecological setting, as the species is no longer found in open grasslands and currently only occupies wet habitat within the margins of seeps and streams.

Under the current condition, the Kern Plateau salamander is thought to continue to occupy the historical range of the species. Overall, the resiliency of the Kern Plateau and the Scodie Mountain geographic groups is likely reduced from historical conditions due to the impacts of roads, recreation, grazing, timber harvest, hazard tree removal, fire, and climate change. While the habitat of the Inyo Geographic Group is currently impacted by some existing threats, the resiliency of the geographic group is likely similar to historical conditions. The Kern Plateau salamander continues to maintain redundancy similar to the historical condition, occupying 35 sites over a range of elevations and three distinct geographic areas. In terms of representation, the Kern Plateau salamander continues to persist in the historical ecological setting that encompasses a range habitat types, elevations, and geographic areas.

Future Condition

Our analysis of the future condition of the 3SS found that climate change and fire are expected to have the greatest influence on the future viability of the species. We considered the future condition of the 3SS over 50 years under two future scenarios. The first scenario predicts intermediate greenhouse gas emissions (RCP 4.5) resulting in the continuation of the current trends of increased warming and frequency and severity of droughts, floods, and fire. The second scenario predicts higher greenhouse gas emissions (RCP 8.5) resulting in a much greater increasing trend in warming; frequency and severity of extreme weather events; and scale and severity of fire. We expect timber harvest and hazard fuel treatment will increase as a result of the changes in climate under both future scenarios, with greater increases predicted under Scenario 2. As there is no available information to suggest that the existing threats of roads, recreation, grazing, and infrastructure will change in the future, we expect these threats will continue to persist at the same magnitude as under the current condition in both future scenarios.

Under future Scenario 1, we anticipate increased temperatures, decreased spring snow water equivalents, decreased spring and summer total soil moisture, and increased fire threat throughout the range of the 3SS. Increased incidence of droughts and floods, timber harvest, hazard tree removal, and fire are expected to degrade the condition of slender salamander habitat. Additionally, reduced water levels in spring and summer and increased drying of soil combined with the continued stresses to habitat by road maintenance, recreation, grazing, and infrastructure is expected to reduce the condition of seep, spring, and creek margin habitat within several geographic groups of the 3SS. We expect that the resiliency of geographic groups or populations of the three species will be reduced from the current condition under this scenario. Lower resiliency of the extant relictual slender salamander geographic groups will render the remaining geographic groups vulnerable to stochastic events. Additionally, the redundancy and representation of the relictual slender salamander is expected to decline from the current condition, leaving the species more vulnerable to extirpation from catastrophic events. While the resiliency of the Kern Canyon slender salamander geographic groups is expected to decline, the species is expected to maintain redundancy and representation similar to the current condition. The resiliency of the Kern Plateau salamander geographic groups is anticipated to be reduced. However, the Kern Plateau salamander will likely retain redundancy and representation similar to the current condition.

Under future Scenario 2, where climate change is projected by RCP 8.5 and increasing threats include extreme weather events of drought and flooding and high-severity fire, we expect that all geographic groups of the 3SS will experience habitat loss. Under conditions for this scenario the 3SS will experience further increased temperatures, decreased spring snow water equivalent, decreased spring and summer total soil moisture, and increased incidence of timber harvest, hazard tree removal, and fire. We anticipate the loss of seep, spring, and creek margin habitat and suitable microhabitat which will greatly reduce the resiliency of all geographic groups of the 3SS. Furthermore, with less suitable habitat and fewer remaining occupied sites within geographic groups, the redundancy of the 3SS is expected to be reduced from the current condition. The representation of the 3SS is also expected to decline as the species will occupy smaller areas encompassing fewer watersheds and smaller ranges of elevation. Under this scenario, the anticipated reduced resiliency, redundancy, and representation of the 3SS will result in all three species being more vulnerable to catastrophic events, which are expected to occur more frequently in the future.

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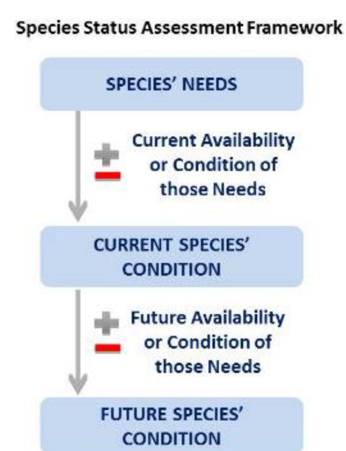
Chapter 1: Introduction

The three salamander species (three slender salamanders; 3SS), the relictual slender salamander (*Batrachoseps relictus*), the Kern Canyon slender salamander (*Batrachoseps simatus*), and the Kern Plateau salamander (*Batrachoseps robustus*) are found almost entirely within the Sequoia National Forest. On July 11, 2012, we, the U.S. Fish and Wildlife Service (Service), received a petition dated July 11, 2012, from the Center for Biological Diversity, requesting that 53 species of reptiles and amphibians, including the three slender salamander species, be listed as endangered or threatened and critical habitat be designated under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531–1543) (Act). We published a 90-day finding in the Federal Register on July 1, 2015, indicating that the petition presented substantial scientific and commercial information that the listing of the relictual slender salamander and the Kern Canyon slender salamander may be warranted under the Act (80 FR 37568–37579, July 1, 2015). On September 28, 2015, we published a 90-day finding in the Federal Register indicating that the petition presented substantial scientific and commercial information that the listing of Kern Plateau salamander may be warranted under the Act (80 FR 56423–56432, September 18, 2015). In the May 2019 National Listing Workplan, we committed to a deadline of September 30, 2021, for submitting to the Federal Register a 12-month finding on the Kern Canyon slender salamander and the Kern Plateau salamander and a deadline of September 31, 2023, for a 12-month finding on the relictual slender salamander (USFWS 2021). Therefore, a review of the status of the relictual slender salamander, Kern Canyon slender salamander, and Kern Plateau salamander was initiated to determine if the petitioned actions are warranted. Based on the status review, we will issue a 12-month finding for each species.

The Species Status Assessment (SSA) framework (Figure 1; USFWS 2016) summarizes the information we assembled and reviewed, incorporating the best available scientific and commercial data, to conduct an in-depth review of a species' biology and threats, evaluate its biological status, and assess its resources and conditions needed to maintain long-term viability. For the purpose of the assessment, we define the viability of the 3SS as their ability to sustain populations in the wild currently and into the future. Using the SSA framework, we consider what each species needs to maintain viability through an assessment of their resiliency, redundancy, and representation (Smith *et al.* 2018, entire). This SSA Report documents the results of the status review for the 3SS and serves as the biological underpinning of our forthcoming decision on whether the species warrant protection under the Act.



The SSA Report uses the conservation biology principles of resiliency, redundancy, and representation (collectively known as the "3Rs") as a lens to evaluate the current and future condition of the species.

Resiliency is the ability of a species to withstand stochastic events, the normal year-to-year variations in both environmental conditions (i.e., temperature, rainfall, and periodic disturbances such as fires, floods, and storms) and demographic conditions (i.e., mortality, fecundity) (Redford *et al.* 2011, p. 40). Determined by the size and growth rate of the populations comprising the species, resiliency can be evaluated to gauge the ability of a species to weather the natural range of favorable and unfavorable conditions.

Redundancy is the ability of a species to withstand catastrophic events, i.e., natural or anthropogenic stochastic events that would result in the loss of a substantial component of the overall geographic group. Characterization of a species' redundancy takes into consideration both an assessment of the size and distribution of its geographic group(s), and an evaluation of the kinds and likelihood of reasonably plausible catastrophic events to which the species could be exposed.

Representation is the ability of a species to withstand and adapt to long-term changes in environmental conditions (i.e., significant changes outside the range of normal year-to-year variations). The measure of a species' representation may be determined by the breadth of genetic and environmental diversity within and among populations.

In summary, this SSA Report is a scientific review of the best available information, including scientific literature and discussions with experts, related to the biology and conservation status of the three salamander species.

Chapter 2: Species Background

2.1 Taxonomy

The three slender salamanders (3SS) belong to the family Plethodontidae, known as the lungless salamanders. Plethodontidae salamanders are highly susceptible to cutaneous water loss and desiccation as they depend on skin and buccopharyngeal respiration in which oxygen is taken up simply by diffusion across moist membranes or by the contraction and relaxation of the muscles of the cheeks or mouth and throat. All three species are within the slender salamander genus of *Batrachoseps*. Species within this genus are known for their long and thin bodies that allow them to fit into small crevices for shelter and to find food (Stebbins and McGinnis 2012, pp.124–127). Slender salamanders are considered highly sedentary and are thought to have high site fidelity (Hendrickson 1954, p. 12; Cunningham 1960, p. 96). The southern Sierra Nevada region has a relatively high diversity of slender salamander species, many of which have only recently been described (Jockusch and Wake 2002, entire; Jockusch *et al.* 2012, entire; Stebbins and McGinnis 2012, p. 124; Jockusch *et al.* 2020, entire).

2.2 Species Descriptions

The ranges of the 3SS, as estimated by Evelyn and Sweet (2012), are shown in relation to each other and the National Forest boundaries in Figure 1. As systematic surveys have not been carried out for the species, these ranges were estimated using available occurrence data yielded from opportunistic searches over limited areas. In the absence of information on the population structure of the 3SS and to aid our analysis in this SSA Report, we divided the known sites of each species into geographic groups. Site specific information for each species is discussed further below in Sections 2.2.2–2.2.4.

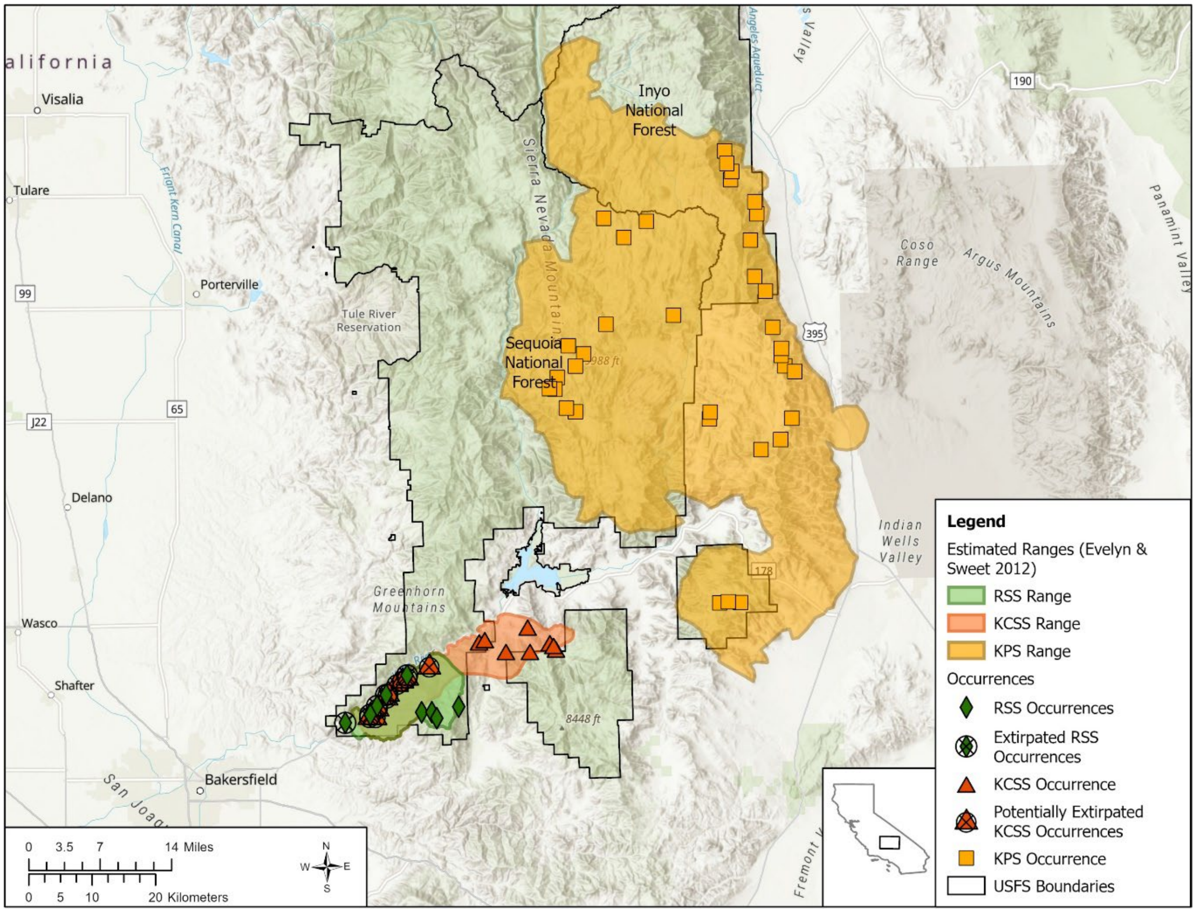


Figure 1: The estimated ranges (Evelyn and Sweet 2012, pp. 104, 110, 116) and occurrence data (CNDDB 2022, unpaginated) for the relictual slender salamander (RSS), Kern Canyon slender salamander (KCSS), and Kern Plateau salamander (KPS). The occurrence points do not represent one individual, but rather a site where one or more salamanders have been found. The points should be considered approximate locations.

2.2.1 Uncertainty

Data availability varies for each of the 3SS species and across the range of each species. As mentioned above, widespread systematic surveys for the species have not been conducted. Therefore, the best available information on the 3SS comes from recorded incidental observations and opportunistic searches over limited areas. Due to the nature of these records of observations, the survey effort for the 3SS is not standard from one site to another, across geographic groups, or from species to species. Most of the survey effort has been concentrated near roads in more accessible areas. Furthermore, negative surveys for the 3SS are often not reported to the California Natural Diversity Database (CNDDB; Jockusch *in litt.* 2021b, p. 2). Additionally, the species are cryptic with presumably low detectability as they are only active on the surface when conditions are favorable and when they are active on the surface, they shelter under cover objects during the day. Some of the sites where salamanders have been observed in the past, have not been searched for the species in the last 30–40 years. In these cases, there is considerable uncertainty as to whether the species continues to occupy the sites. In the absence of more recent information, we assume that the 3SS continue to occupy sites where habitat conditions remain suitable. The tables below in Sections 2.2.2–2.2.4 provide the best available site-specific information for each species. Along with other information, the tables include the last year salamanders were observed at each site, the last year the site was searched for the species, and whether the species is presumed to be extant at the site. If there is no information to indicate otherwise, the 3SS are presumed to be extant at all sites where they have been observed in the past. Figure 2 shows the most recent recorded observation occurred at each site throughout the range of the 3SS. Species specific maps indicating when the most recent observations occurred at each site can be found in the appendix of this SSA Report.

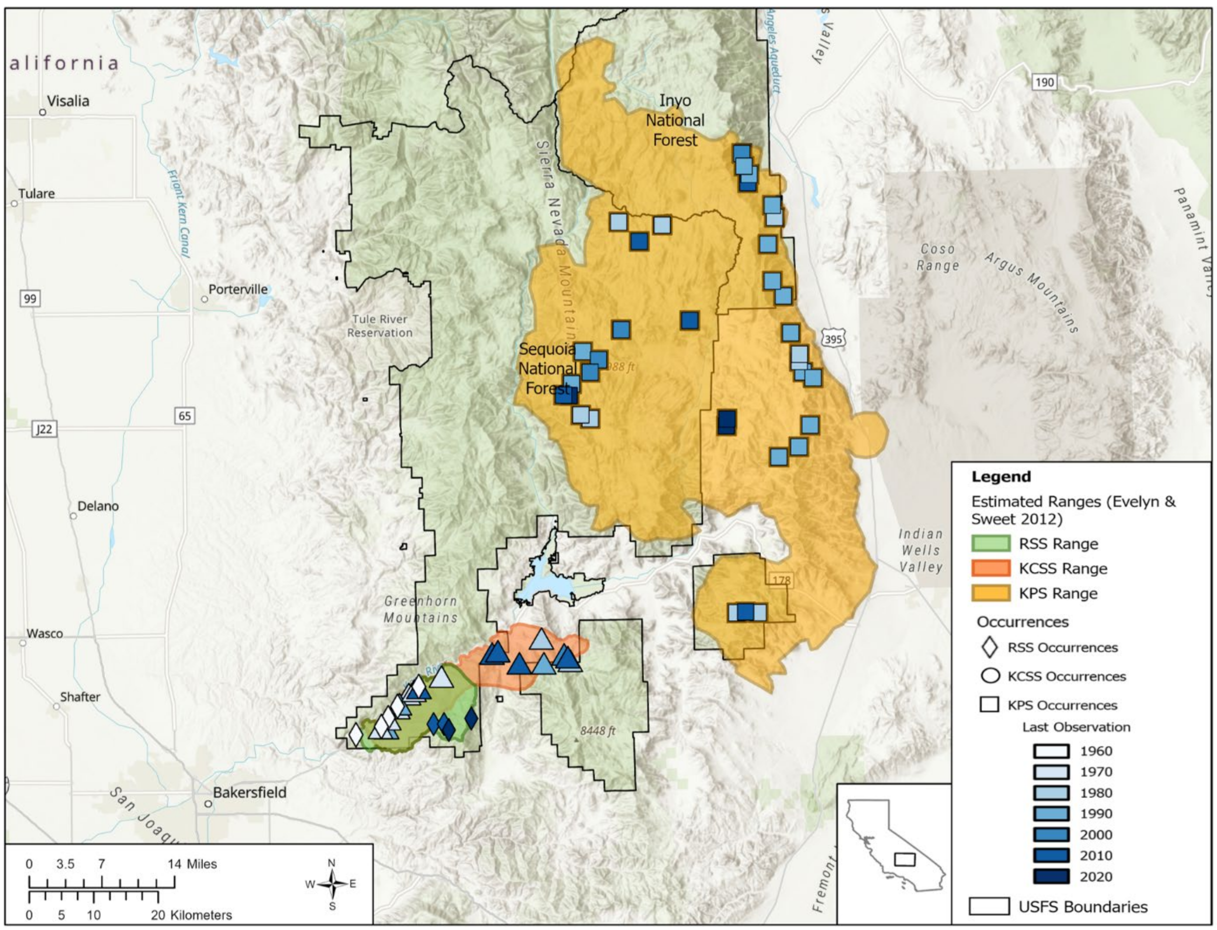


Figure 2: The most recent observations at known sites of the relictual slender salamander (RSS), Kern Canyon slender salamander (KCSS), and Kern Plateau salamander (KPS; CNDDB 2022, unpaginated).

2.2.2 Relictual Slender Salamander

The relictual slender salamander has a short, slender body and moderately long limbs (approximately 33.0–46.9 millimeters (mm) (1.3–1.9 inches (in)) snout-vent length) with 18–19 costal grooves (Jockusch *et al.* 2012, p. 14; Stebbins and McGinnis 2012, p. 139). The coloration of relictual slender salamanders is blackish brown with a red, yellow, or brown dorsal stripe. Primary habitat for the species is composed of seeps, perennial springs, and small streams in rocky areas with limited tree cover of oaks (*Quercus* spp.), buckeyes (*Aesculus* spp.), sycamores, pines (*Pinus* spp.), and firs (*Abies* spp.; Jennings and Hayes 1994, pp. 18–22). The relictual slender salamander has the smallest range of the described species of slender salamander. The estimated historic range of the species encompasses 13,423 hectares (ha; 33,169 acres (ac)) and falls almost entirely within Sequoia National Forest (Figure 3; Evelyn and Sweet 2012, p. 104). The species is known historically from 13 sites: 5 sites on the south side of the Kern River in the Lower Kern River Canyon from 365–731 meters (m) (1,200–2,400 feet (ft)), and 8 sites on Breckenridge Mountain from 1,219–1,920 m (4,000–6,300 ft; See Table 1 below). To aid our analysis in this SSA Report we divided the range of the species into three geographic groups: the Lower Kern River Canyon Geographic Group, the Lucas Creek Geographic Group, and the Squirrel Meadow Geographic Group.

The relictual slender salamander has not been found in the Lower Kern River Canyon since 1968 (Jennings and Hayes 1994, p. 22; Lannoo 2005, p. 688; Jockusch *et al.* 2012, p. 17), despite as described by Robert Hansen (1997) "repeated and careful searches at various wet places along Highway 178 in the Kern Canyon." Habitat degradation associated with construction, maintenance, and enhancement of State Route 178 may have contributed to the extirpation of the relictual slender salamander from the Lower Kern River Canyon (Lannoo 2005, p. 688). Surveys in the Lower Kern River Canyon conducted in the decade following construction of the highway concluded that the species had been extirpated from the Lower Kern River Canyon (See Table 1 below). Because the relictual slender salamander was determined to be extirpated from the Lower Kern River Canyon and the distance to occupied sites on Breckenridge Mountain near Lucas Creek and Squirrel Meadow is thought to be too great for natural dispersal, no additional surveys were conducted for the relictual slender salamander in the Lower Kern River Canyon.

The two extant geographic groups on Breckenridge Mountain are separated by less than 5.0 km (3.1 mi). On Breckenridge Mountain, the species is found in pine-fir forest (*Pinus* spp.-*Abies* spp.; Jockusch *et al.* 2012, p. 17). Three sites occupied by the relictual slender salamander on Breckenridge Mountain are within creek margin habitat and seep and spring habitat along Lucas Creek and two tributaries to Lucas Creek. In this SSA Report, we refer to the three sites associated with Lucas Creek and its tributaries as the Lucas Creek Geographic Group. On Breckenridge Mountain to the east of Lucas Creek, a small seep northeast of Squirrel Meadow provides habitat for the relictual slender salamander. Communication with species experts indicates there are four sites occupied by the relictual slender salamander within the Mill Creek and Flying Dutchman Creek drainages at mid to high elevations on Breckenridge Mountain that were discovered in 2019 (see Table 1 below; Jockusch *in litt.* 2021a, p. 2; Hansen *in litt.* 2021, p. 1). More than 20 salamanders were found at two of these sites and at one site juveniles were observed (E. Jockusch *in litt.* 2021a, p. 2; R. Hansen 2021, p. 1). We lack detailed and specific information on the location of these four sites (See Table 1 below; these sites are not mapped in Figure 3). We refer to the site associated with the seep northeast of Squirrel Meadow and the four sites associated with the Mill Creek and Flying Dutchman Creek drainages as the Squirrel Meadow Geographic Group in this SSA Report. The intermediate elevations of Breckenridge Mountain, between the Lower Kern River Canyon and the occupied sites on Breckenridge Mountain, have not been extensively surveyed for the species (Jennings and Hayes 1994, p. 22; Lannoo 2005, p. 687; Jockusch *et al.* 2012, p. 18). Surveys on both the northern and southern slopes of Breckenridge Mountain are warranted (Jennings and Hayes 1994, p. 22; Lannoo 2005, p. 687; Jockusch *et al.* 2012, p. 18; E. Jockusch *in litt.* 2021a, p. 2).

On Breckenridge Mountain relictual slender salamanders have been found active on the surface between March and early November (Jockusch *et al.* 2012, p. 17; E. Jockusch *in litt.* 2021a, p. 2). At lower elevations within the historical range of the species in the Kern River Canyon, relictual slender salamanders have been found on the surface between January and May. The relictual slender salamander has been described as "semi-aquatic" and are the species is thought to have a closer association with aquatic habitat than other species of slender salamanders (Stebbins 1985, p. 48). Individuals have been found submerged in seeps and springs and under cover objects with water beneath them (Lannoo 2005, p. 687; Jockusch *et al.* 2012, p. 17). Information on the natural history of the species is limited, as many published reports referring to relictual slender salamanders focused on salamanders that were later re-classified as the Greenhorn Mountains slender salamander (*Batrachoseps altasierrae*) (Jockusch *et al.* 2012, p. 5).

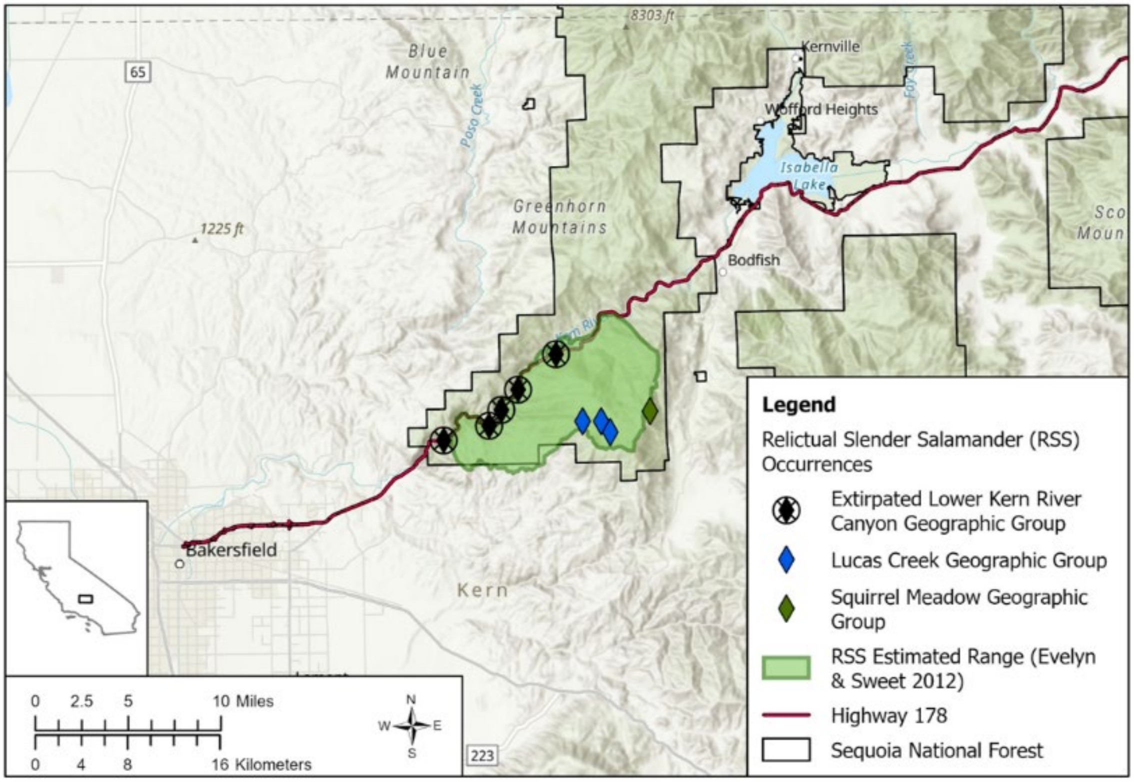


Figure 3: The estimated range (Evelyn and Sweet 2012, p. 104) and occurrence data (CNDDB 2022, unpaginated) of the relictual slender salamander (RSS). The occurrence points do not represent one individual, but rather a site where one or more salamanders have been found. The points should be considered approximate locations. The middle occurrence point (Lucas Creek B) in the Lucas Creek Geographic Group encompasses two CNDDB occurrence records that are considered to be one continuous site (E. Jockusch *in litt.* 2021b, p. 3). Four sites (Flying Dutchman Drainage and Mill Creek Drainage A, B, and C) are not mapped because the specific locations of the sites have not been reported to CNDDB (See Table 1).

Table 1: Relictual Slender Salamander Sites (CNDDB 2022, unpaginated; E. Jockusch *in litt.* 2021a, p. 2)

Site	Geographic Group	Range of No. Observed	Year First Observed	Year Last Observed	Year Last Surveyed	Presumed Extant?
Cow Flat Creek	Lower Kern River Canyon	0–12	1955	1968	1979*	No
Lucas Creek A	Lower Kern River Canyon	0–6	1960	1960	1975*	No
Unnamed Tributary (E Democrat Hot Springs)	Lower Kern River Canyon	0–8	1964	1964	1964*	No
Stark Creek	Lower Kern River Canyon	0–4	1964	1964	1964*	No

Site	Geographic Group	Range of No. Observed	Year First Observed	Year Last Observed	Year Last Surveyed	Presumed Extant?
Unnamed Tributary (SW Democrat Hot Springs)	Lower Kern River Canyon	0–3	1967	1967	1967*	No
Lucas Creek B**	Lucas Creek	1–8	2001	2019	2019	Yes
Tributary to Lucas Creek A	Lucas Creek	2	2017	2017	2017	Yes
Tributary to Lucas Creek B	Lucas Creek	1	2021	2021	2021	Yes
NE of Squirrel Meadow	Squirrel Meadow	0–30	1977	2021	2021	Yes
Flying Dutchman Drainage	Squirrel Meadow	Information not available	2019	2021	2021	Yes
Mill Creek Drainage A	Squirrel Meadow	Information not available	2019	2021	2021	Yes
Mill Creek Drainage B	Squirrel Meadow	Information not available	2019	2021	2021	Yes
Mill Creek Drainage C	Squirrel Meadow	Information not available	2019	2019	2019	Yes
Geographic Group Summary	**Lower Kern River Canyon**	**0–12**	**1955**	**1968**	**1979***	**No**
Geographic Group Summary	**Lucas Creek**	**1–8**	**2001**	**2021**	**2021**	**Yes**
Geographic Group Summary	**Squirrel Meadow**	**0–30**	**1977**	**2021**	**2021**	**Yes**

* This site has been searched for the species since the year identified as the "year last surveyed" (Hansen 1997, entire; Jennings and Hayes 1994, p. 22; Lannoo 2005, p. 687). However, the more recent negative surveys have not been reported to CNDDB.
** This site encompasses two CNDDB occurrences along Lucas Creek that are considered to be one site (E. Jockusch *in litt.* 2021b, p. 3).

2.2.3 Kern Canyon Slender Salamander

The Kern Canyon slender salamander has a narrow head, 20–21 costal grooves, and long and slim body, tail, and legs (approximately 40.6–55.9 mm (1.6–2.2 in) snout-vent length; Stebbins and McGinnis 2012, p. 130). The side and ventral surfaces of the Kern Canyon slender salamander are dark brown with flecks of lighter color and the dorsal surface may be striped or patterned with flecks of bronze and red. The species is known to inhabit wet creek and seep margins within north-facing riparian zones in narrow canyons shaded with willows (*Salix* spp.), cottonwoods (*Populus* spp.) and on wooded hillsides supporting oaks (*Quercus* spp.) and pines

(*Pinus* spp.; Lannoo 2005, pp. 691–693). The species has also been found on talus slopes and open grasslands (Lannoo 2005, pp. 691–693). Kern Canyon slender salamanders are active on the surface in the winter and early spring and are found primarily under rocks, logs, bark, and leaf litter.

The estimated range of the Kern Canyon slender salamander encompasses 21,496 ha (53,117 ac) along the south side of the Lower Kern River Canyon within Kern County, CA (Figure 4; Evelyn and Sweet 2012, p. 116). The species is known from habitat that ranges from 451–1,676 m (1,480–5,500 ft) above sea level. The known sites of the Kern Canyon slender salamander at lower elevation are within the Lower Kern River Canyon and higher elevation sites are along Bodfish and Erskine Creeks and in the Piute Mountains. Eighty-one percent of the estimated range of the Kern Canyon slender salamander is within the Sequoia National Forest and 19 percent is on privately owned land. The species is known from 18 sites (See Table 2 below). The specific location of two sites of the Kern Canyon slender salamander has not been reported to CNDDB. One of these sites (Eagle Peak; See Table 2) is mapped to a general description of the location of the site and the other site (Bodfish Creek B) is not mapped in the maps within this SSA report (E. Jockusch *in litt.* 2021a, p. 3; E. Jockusch *in litt.* 2021b, p. 2). The Kern Canyon slender salamander has not been observed at many of the sites in the Lower Kern River Canyon in the last 30–40 years so there is uncertainty as to whether the species continues to occupy those sites. Species experts indicate sites in the Lower Kern River Canyon have been searched for the Kern Canyon slender salamander in recent years and negative survey results have not been reported to CNDDB (E. Jockusch *in litt.* 2021b, p. 2). The species may now be largely or entirely absent from the sites to the east of Miracle Hot Springs in the Lower Kern River Canyon (See Table 2; E. Jockusch *in litt.* 2021b, pp. 1–2). For the purposes of this SSA Report, the species' range was divided into two geographic groups: the Lower Kern River Canyon group, which falls entirely within Sequoia National Forest, and the Erskine Creek Canyon group, which consists of the sites outside Sequoia National Forest at higher elevations primarily within Erskine Creek Canyon and Bodfish Creek Canyon.

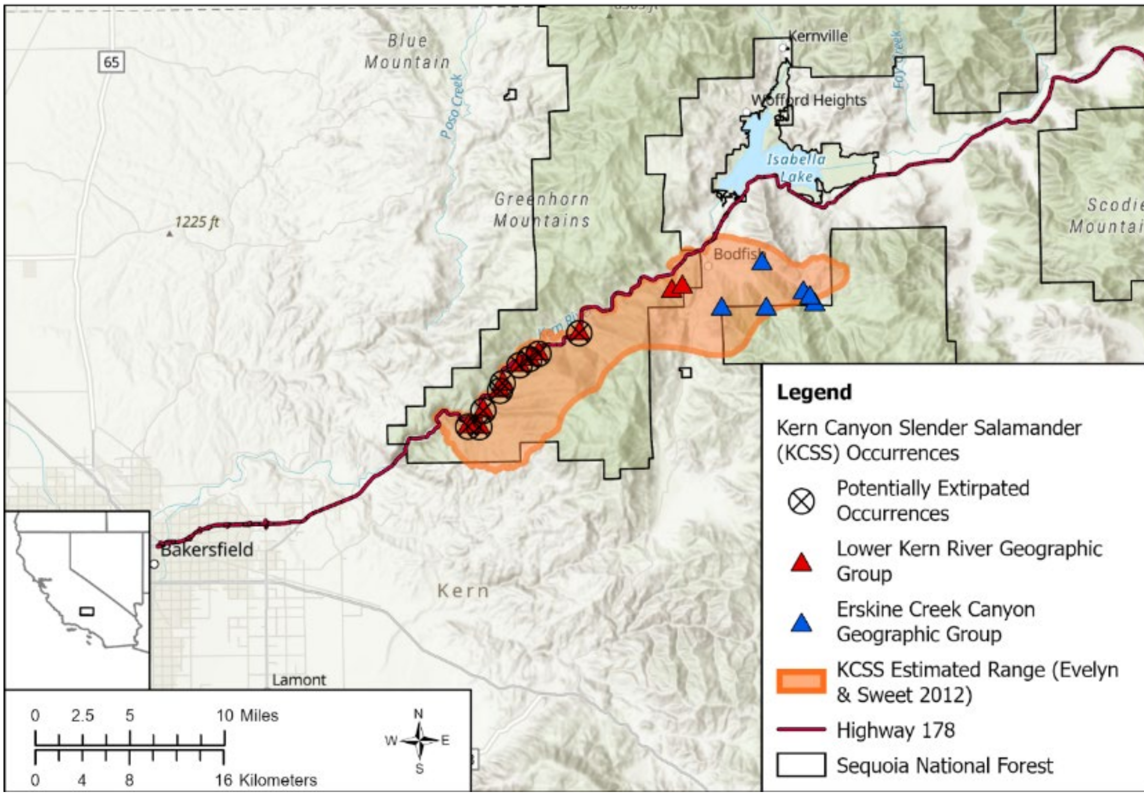


Figure 4: The estimated range (Evelyn and Sweet 2012, p. 116) and occurrence data (CNDDB 2022, unpaginated; E. Jockusch *in litt.* 2021a, p. 3) for the Kern Canyon slender salamander (KCSS). The occurrence points do not represent one individual, but rather a site where one or more salamanders have been found. The points should be considered approximate locations. One site (Bodfish Creek B) is not mapped here because the specific location of the site has not been reported to CNDDB (See Table 2). The Eagle Peak site is mapped to a general description of the location as the site has not been reported to CNDDB (E. Jockusch *in litt.* 2021a, p. 3).

Table 2: Kern Canyon Slender Salamander Sites (CNDDB 2022, unpaginated; E. Jockusch *in litt.* 2021a, p. 3)

Site	Geographic Group	Range of No. Observed	Year First Observed	Year Last Observed	Year Last Surveyed	Presumed Extant?
Cow Flat Creek	Lower Kern River Canyon	0–5	1952	1970	1979*	No**
Stark Creek	Lower Kern River Canyon	1–7	1960	1979	1979*	No**
SE of HWY 178	Lower Kern River Canyon	2–11	1960	1978	1979*	No**
Unnamed drainage (SW Democrat Hot Springs)	Lower Kern River Canyon	1	1970	1970	1970*	No**
Dougherty Creek	Lower Kern River Canyon	1–8	1970	1991	1991*	No**

Site	Geographic Group	Range of No. Observed	Year First Observed	Year Last Observed	Year Last Surveyed	Presumed Extant?
Lucas Creek	Lower Kern River Canyon	20	1975	1975	1975*	No**
Mill Creek	Lower Kern River Canyon	1	1979	1979	1979*	No**
Miracle Hot Springs	Lower Kern River Canyon	1–12	1979	2008	2008†	Yes
Seep N of Cow Flat Creek	Lower Kern River Canyon	1	1991	1991	1991*	No**
NE of Hobo Campground	Lower Kern River Canyon	1	2007	2018	2018	Yes
S Cow Flat Rd	Lower Kern River Canyon	1	2010	2010	2010	No**
Erskine Creek A	Erskine Creek Canyon	3	1981	1981	1981	Yes‡
Erskine Creek B	Erskine Creek Canyon	12	1981	1981	1981	Yes‡
Erskine Creek C	Erskine Creek Canyon	2–3	1992	1993	1993	Yes
Bodfish Creek A	Erskine Creek Canyon	2	2001	2001	2001	Yes
Erskine Creek D	Erskine Creek Canyon	1	2010	2010	2010	Yes
Eagle Peak	Erskine Creek Canyon	1	2019	2019	2019	Yes
Bodfish Creek B	Erskine Creek Canyon	1	2021	2021	2021	Yes
Geographic Group Summary	Lower Kern River Canyon	0–20	1952	2018	2018	Yes
Geographic Group Summary	Erskine Creek Canyon	1–12	1981	2021	2021	Yes

* More recent negative surveys have not been reported to CNDDB.
** A species expert indicates the Kern Canyon slender salamander may be largely or entirely gone from the site.
† A species expert indicates the Kern Canyon slender salamander has been observed at this site since 2008. However, the year of more recent observations has not been reported to CNDDB.
‡ Surveys for the Kern Canyon slender salamander at this site have not been reported to CNDDB in the last 30–40 years, so there is uncertainty as to whether the species is present.

2.2.3 Kern Plateau Salamander

The Kern Plateau salamander has a broad, robust body with 16–17 costal grooves and a relatively short tail (approximately 44.5–57.2 mm (1.8–2.3 in) snout-vent length; Stebbins and McGinnis 2012, p. 128). The coloration of Kern Plateau salamanders varies from rusty to gray or silver with dark flecks or spots, which are unique for slender salamanders (Lannoo 2005, pp. 690–691). Kern Plateau salamanders inhabiting drier areas tend to have lighter coloring than individuals inhabiting wetter areas (Lannoo 2005, pp. 690–691). Throughout its range, the Kern

Plateau salamander is primarily found under cover objects near springs, seeps, and outflow streams (Lannoo 2005, p. 690). In the eastern part of the species' range, Kern Plateau salamanders inhabit arid habitat with lodgepole pine (*Pinus contorta*), pinyon pine (*P. edulis*), black oak (*Quercus velutina*), canyon oak (*Q. chrysolepis*), big sagebrush (*Artemisia tridentata*), and rabbitbrush (*Chrysothamnus spp.*). In this arid habitat in the eastern part of the species' range, Kern Plateau salamanders are active on the surface in the early summer and are found in cool, damp microhabitat under rocks where temperatures are between 5.0–13.5 degrees Celsius (°C) (41.0–56.3 degrees Fahrenheit (°F)) and the soil retains moisture (Lannoo 2005, pp. 690–691). In the western part of the species' range on the Kern Plateau, Kern Plateau salamanders inhabit moister habitat within mesic pine-fir forests that include Jeffrey pine (*P. jeffreyi*) and red fir (*Abies magnifica*). In mesic habitat, Kern Plateau salamanders are active on the surface in late spring and summer. Kern Plateau salamanders are more broadly distributed in leaf litter and under logs and rocks in mesic habitats than in arid habitat (Lannoo 2005, pp. 690–691).

The estimated range of the Kern Plateau salamander encompasses 302,035 ha (746,347 ac; Evelyn and Sweet 2012, p. 110). The species is known from 35 sites (Table 3). The sites are spread across areas of Sequoia National Forest and Inyo National Forest and privately owned land on the eastern slope of the Sierra Nevada (Figure 5). Twelve of the recorded sites of the Kern Plateau salamander have not been surveyed in the last 30–40 years, so there is uncertainty as to whether the species is still present at those sites. For the purposes of this SSA Report, the range of the Kern Plateau salamander was divided into three geographic groups: the Kern Plateau Geographic Group, which encompasses sites ranging in elevation from 1,705–2,804 m (5,596–9,200 ft) in the southwestern Sierra Nevada in Kern County, CA; the Inyo Geographic Group, which encompasses sites ranging in elevation from 1,434–2,045 m (4,705–6,709 ft) on the eastern slope of Sierra Nevada in Inyo County, CA; and the Scodie Mountain Geographic Group, which encompasses sites ranging in elevation from 2,011–2,042 m (6,600–6,700 ft) in the Scodie Mountains in Kern County, CA. The Kern Plateau and Scodie Mountain Geographic Groups are entirely within the Sequoia National Forest. The Scodie Mountain Geographic Group also falls within the Kiavah Wilderness. The Inyo Geographic Group includes areas in the Inyo National Forest and outside of the National Forest in Owens and Indian Wells Valleys.

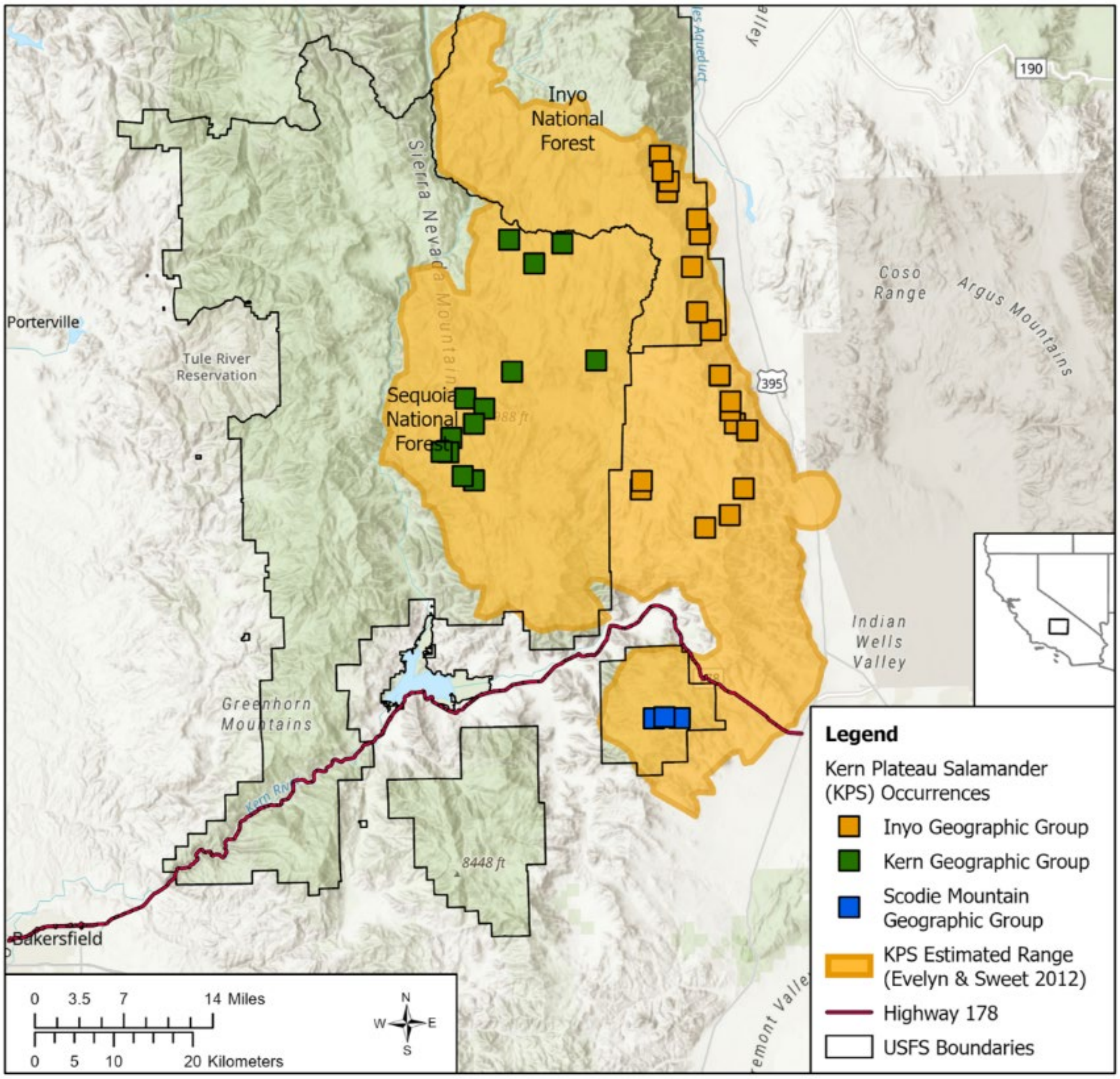


Figure 5: The estimated range (Evelyn and Sweet 2012, p. 110) and occurrence data (CNDDB 2022, unpaginated) for the Kern Plateau salamander (KPS). The occurrence points do not represent one individual, but rather a site where one or more salamanders have been found. The points should be considered approximate locations.

Table 3: Kern Plateau Salamander Sites (CNDDB 2022, unpaginated; C. Evelyn *in litt.* 2021, p. 2)

Site	Geographic Group	Range of No. Observed	Year First Observed	Year Last Observed	Year Last Surveyed	Presumed Extant?
N Long Valley	Inyo	1–13	1983	2020	2020	Yes
Hogback Creek	Inyo	1–10	1985	1995	1995	Yes
Walker Creek	Inyo	2–6	Late 1980s/ Early 1990s	1995	1995	Yes
Rockhouse Basin Rd	Inyo	1–16	1980	2020	2020	Yes

Site	Geographic Group	Range of No. Observed	Year First Observed	Year Last Observed	Year Last Surveyed	Presumed Extant?
Falls Creek	Inyo	1–2	1986	1995	1995	Yes
Olancha Creek	Inyo	1–4	1988	2007	2007	Yes
Upper and Lower Talus Canyon	Inyo	1–4	1988	1995	1995	Yes
S Tributary to Fivemile Canyon	Inyo	1–2	1988	1996	1996	Yes
Upper Little Lake Canyon	Inyo	1–3	1988	1996	1996	Yes
Ninemile Canyon	Inyo	1–7	1988	1995	1995	Yes
Lower Upper Little Lake Canyon	Inyo	1	1988	1996	1996	Yes
Southern Reach of Unnamed Drainage (N of Little Lake Canyon)	Inyo	1	1988	1988	1988	Yes*
Northern Reach of Unnamed Drainage (N of Little Lake Canyon)	Inyo	1	1988	1988	1988	Yes*
Unnamed Canyon (S of Hogback Creek)	Inyo	2	1988	1988	1988	Yes*
Haiwee Creek	Inyo	2	1988	1995	1995	Yes
Tunawee Canyon	Inyo	1	1988	1996	1996	Yes
Small Creek	Inyo	2–6	1989	2017	2017	Yes
Chimney Creek	Inyo	1	1993	1993	1993	Yes
Portuguese Canyon	Inyo	1	1995	1995	1995	Yes
NE Beach Meadows	Kern Plateau	1–3	1972	2016	2016	Yes
Cherry Hill Rd (N of Poison Meadow)	Kern Plateau	2–5	1980	2021	2021	Yes
NE of Horse Meadow Campground	Kern Plateau	1	1980	1980	1980	Yes*
ESE of Horse Meadow Campground	Kern Plateau	1	1980	1980	1980	Yes*
Monache Jeep Rd	Kern Plateau	1	1980	1980	1980	Yes*
SE of Osa Meadow	Kern Plateau	13	1980	1980	1980	Yes*
SSE of Burton Camp	Kern Plateau	3–8	1980	1991	1991	Yes*
Tributary to Bitter Creek	Kern Plateau	1–7	1980	2019	2019	Yes
SE of Round Meadow	Kern Plateau	1–19	1991	2002	2002	Yes
Cherry Hill Rd (upper Poison Meadow Creek)	Kern Plateau	2–8	1991	2015	2015	Yes
Sherman Pass (N Durrwood Meadows)	Kern Plateau	1	1991	1991	1991	Yes*
Sherman Pass-Troy Meadow Rd	Kern Plateau	1–2	1991	2001	2001	Yes

Site	Geographic Group	Range of No. Observed	Year First Observed	Year Last Observed	Year Last Surveyed	Presumed Extant?
Tributary of Trout Creek	Kern Plateau	1	2000	2000	2000	Yes
McIver's Spring	Scodie Mountain	5–16	1979	1980	2017	Yes
W of McIver's Spring	Scodie Mountain	7	1980	1980	1980	Yes*
Unnamed Tributary (W of McIver's Spring)	Scodie Mountain	1	2017	2017	2017	Yes
Geographic Group Summary	**Inyo**	**1–16**	**1980**	**2020**	**2020**	**Yes**
Geographic Group Summary	**Kern Plateau**	**1–19**	**1972**	**2021**	**2021**	**Yes**
Geographic Group Summary	**Scodie Mountain**	**1–16**	**1979**	**2017**	**2017**	**Yes**

*The site has not been searched for the Kern Plateau salamander (KPS) in the last 30–40 years, so there is uncertainty as to whether the species is present at the site.

2.3 Life History & Ecology

Little is known about the species-specific life history and ecology of the 3SS. However various characteristics are common across species of slender salamanders. Salamanders are well known for their vulnerability to desiccation, as their permeable skin provides little resistance to water loss (Spotila and Berman 1976, entire; Rothermel and Luhring 2005, p. 625). When exposed to arid environments, fatal desiccation can occur in some lungless salamanders (family: Plethodontidae) in less than one hour (Ray 1958, p. 78), suggesting that desiccation acts as a strong selective pressure in this family. To avoid desiccation, slender salamanders are active on the surface only when substrate is adequately moist, and temperatures are suitable. They are thought to retreat underground to escape temperature and moisture extremes and use passages made by other animals or produced by root decay, soil shrinkage, or water erosion for underground burrows (Cunningham 1960, p. 95; Lannoo 2005, pp. 688–693). When conditions are favorable, slender salamanders are thought to be active on the surface at night. During the day they stay in cool, damp microhabitats under the cover of woody debris, rocks, and leaf litter or in underground burrows. At elevations below approximately 1,500 m (4,921 ft), the 3SS have been observed on the surface between winter and spring and likely seek shelter underground during warmer and drier months in the summer and fall. At elevations above approximately 1,500 m (4,921 ft), the 3SS have been found on the surface after snow cover recedes in late spring and through early fall. The 3SS are most often observed under cover objects in proximity to sources of surface water such as seeps, perennial springs, and streams (Lannoo 2005, pp. 688–693). The species is cryptic with presumably low detectability as it is only active on the surface when conditions are favorable and when it is active on the surface, it shelters under cover objects during the day.

The 3SS likely feed opportunistically above and below ground. Like other slender salamanders, their diet is thought to be composed of small invertebrates, earthworms, and slugs that they forage for under bark, talus rocks, and leaf litter (Cunningham 1960, p. 98; Adams 1968, p. 171; Stebbins and McGinnis 2012, p. 127). The long and narrow bodies of slender salamanders allow them to forage for prey in small cavities and rock crevices, and they use their projectile tongues to catch prey (Stebbins and McGinnis 2012, pp. 124–140). The foraging success of terrestrial salamanders can be influenced by ambient moisture. When leaf litter is dry, salamanders are confined to small patches of moist habitat under rocks and logs or in underground burrows where prey may be scarce (Jaeger 1981, entire). When the litter is moist, salamanders move into the litter where prey are readily available (Jaeger 1981, entire). Additionally, at higher temperatures salamander energy assimilation decreases and salamanders must increase feeding frequency to maintain energy balances (Huey and Kingsolver 2019, entire). If salamanders are not able to increase feeding frequency because of reduced surface activity due to physiological constraints or if prey are not available in sufficient quantities, increased temperature may result in decreased body sizes, growth rates, fecundity, and delayed maturity (Caruso *et al.* 2014, p. 1757; Muñoz *et al.* 2016, p. 8744).

There have been no recorded observations of predation on the 3SS. However, natural predators of these species likely include skunks, ringtails, raccoons, gray foxes, ring-necked snakes, and various skinks, moles, and shrews (Kucera 1997, p. 2; Lannoo 2005, p. 689).

The dispersal ability, home range, and territoriality of the 3SS have not been studied. However, other species of slender salamanders have small home ranges, high site fidelity, and low movement with maximum distances traveled of 3.0–18.3 m (9.8–60.0 ft) (Hendrickson 1954, p. 12; Anderson 1960, p. 369; Cunningham 1960, p. 96). California slender salamanders (*Batrachoseps attenuatus*) repeatedly use the same cover object and on average move only 1.5 m (4.9 ft) over two years (Hendrickson 1954, p. 12). Presumably territories are small or seasonal as breeding sized salamanders are often found close to one another under the same cover object (Hendrickson 1954, p. 12).

Few observations have been recorded regarding reproduction of the 3SS. Slender salamanders are direct developers and lay eggs terrestrially in protected areas, under cover objects in mesic habitat, or at the edge of aquatic habitat (Stebbins 1985, p. 39; Jockusch and Mahoney 1997, entire; Wake 2017, entire). There is no data available on the timing of mating for the 3SS. Gravid relictual slender salamanders and eggs have been observed in the spring and early summer (Wake *et al.* 2002, p. 1026; Jockusch *et al.* 2012, p. 17; E. Jockusch *in litt.* 2021a, p. 2). Additionally, two communal nests of the relictual slender salamander have been reported with numerous gravid females and approximately 125–200 eggs within each nest (Jockusch *et al.* 2012, p. 17; E. Jockusch *in litt.* 2021a, p. 1). These nests were found associate with rocks bordering seeps and streams. Oviposition sites have not been observed for the Kern Canyon slender salamander or the Kern Plateau salamander.

Many species of terrestrial salamanders have parental care that includes brooding (Jockusch and Mahoney 1997, entire); however, it is unknown if the 3SS provide parental care. For other species of slender salamander, the average clutch size ranges from 5–16 eggs and the average time to hatching ranges from 65–126 days (Jockusch and Mahoney 1997, p. 701). *In situ* observations indicate that gravid relictual slender salamanders may carry up to 20 eggs (E. Jockusch *in litt.* 2021a, p. 2). In lab experiments, the Kern Plateau salamander had small clutches of 3–6 eggs and hatching took place after 96–103 days at 13 °C (55.4 °F); Wake *et al.* 2002, p. 1026). Further observations of Kern Plateau salamanders found that hatchlings aggregate in groups of 2–5 and are active on the surface under small cover objects from March to July (Wake *et al.* 2002, p. 1026). While the lifespan of the 3SS is unknown, the maximum age of the closely related species, the California slender salamander, is thought to be 8–10 years with salamanders reaching reproductive maturity after 2–4 years (Hendrickson 1954, p. 19; Wake and Castanet 1995, p. 63). Figure 6 represents the life history of the 3SS to the best of our knowledge.

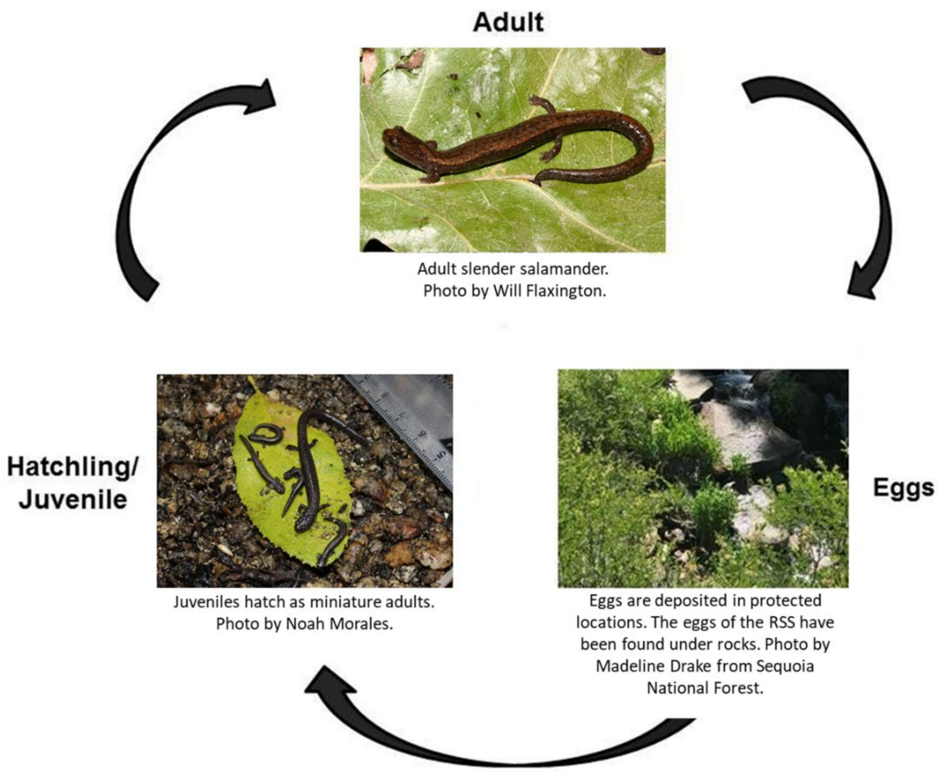


Figure 6: Life history diagram of the 3SS. Adult slender salamanders lay eggs in protected locations during the spring or early summer. Juveniles hatch as miniature adults after approximately 65 to 126 days. Juveniles mature to adults in two to four years.

2.4 Individual Needs

We assessed the best available information to identify the physical and biological needs that support individual fitness at all life stages for the 3SS. The 3SS require bodies of surface water such as seeps, springs, and streams, and associated riparian habitat. In addition, the 3SS require the presence of sufficient refugia consisting of cover objects such as woody debris, bark, leaf litter, rocks, and other cover objects within mesic and riparian habitats. There must be abundant interstitial spaces underneath cover objects or debris to facilitate resting, foraging, and movement of salamanders. Additionally, microclimates underneath cover objects must be cool and moist as the 3SS are susceptible to desiccation. For the purposes of this SSA Report, the habitat factors considered most significant for the 3SS are seeps, springs, and streams; cover objects including woody debris, bark, leaf litter, and rocks that provide refugia within aquatic and riparian habitats; cool and damp microhabitat conditions; and small invertebrate prey. Additionally, the 3SS require access to mates to carry out breeding. Table 4 summarizes our understanding of the individual resource needs of the 3SS by life stage and season.

Table 4: Resource Needs

<table>
<tr><th>Life Stage</th><th>Spring</th><th>Summer</th><th>Fall</th><th>Winter</th></tr>
<tr><td>Eggs</td><td colspan="2">Eggs are deposited.</td><td></td><td></td></tr>
<tr><td>Hatchlings/ Juveniles and Adults at low elevations (below approx. 1,500 m)</td><td>Active on the surface.
Seek shelter in cool and damp microhabitat under cover objects close to seeps, springs, and streams.
Prey on small invertebrates.</td><td colspan="2">Not active on the surface. Shelter in underground burrows.</td><td>Active on the surface.
Seek shelter in cool and damp microhabitat under cover objects close to seeps, springs, and streams.
Prey on small invertebrates.</td></tr>
<tr><td>Hatchlings/ Juveniles and Adults at high elevations (above approx. 1,500 m)</td><td colspan="2">Active on the surface. Seek shelter in cool and damp microhabitat under cover objects close to seeps, springs, and streams. Prey on small invertebrates.</td><td colspan="2">Not active on the surface. Shelter in underground burrows.</td></tr>
</table>

2.5 Population/Geographic Group Needs

At the population level, we used the best available information to assess the resources and circumstances that most influence the resiliency of the 3SS populations. Resiliency describes the ability of populations to withstand stochastic disturbance, such as wildfires and weather anomalies. Resiliency is positively related to population size and growth rate and may be influenced by connectivity among populations. We assume that if there appears to be sufficient suitable habitat and resource needs available, populations should be large and stable enough to be resilient. The population needs identified in this SSA Report include survival, dispersal, fecundity, and abundance. Figure 7 is a conceptual model that shows how the individual needs are thought to influence the population needs, which ultimately affect population resiliency of the 3SS. Because information on population structure and size is not available for the 3SS, we discuss resiliency by geographic group. Representation and redundancy are discussed at the species level.

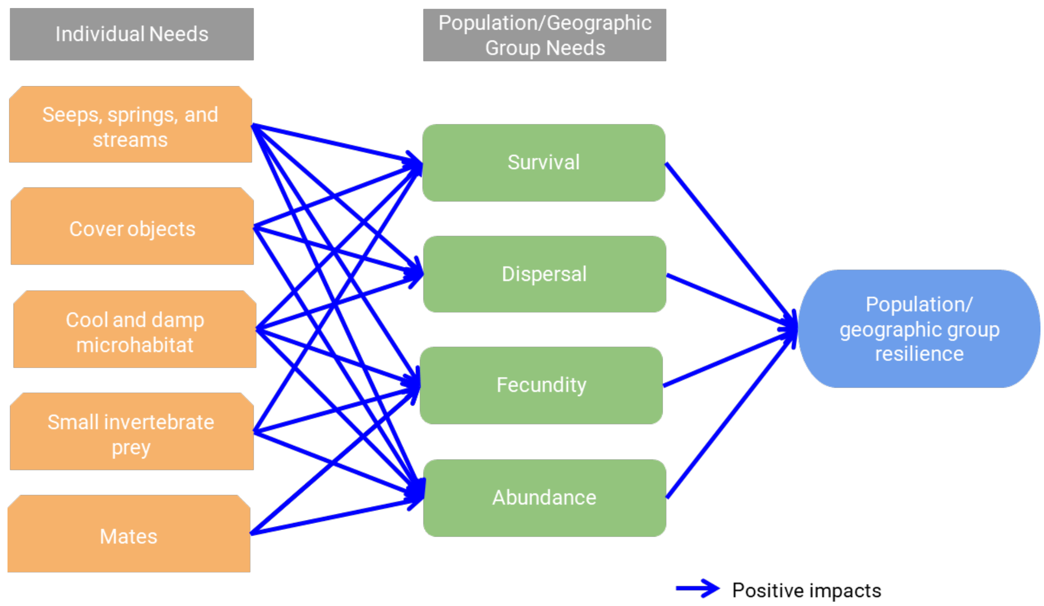


Figure 7: Conceptual model showing the relationship between individual needs and population/geographic group needs, and how these needs influence the resiliency of the slender salamander populations/geographic groups. The blue arrows represent influences showing relationships between varying needs. For example, as prey increases, survival increases, which increases resiliency.

Survival

Survival is defined as individuals persisting. Most of the individual needs identified above in Figure 7 and in section 2.4 influence survival of individuals within a geographic group. Survival may be limited by both the quantity and quality of available habitat including the presence of seeps, springs, and streams; cover objects that provides refugia; and cool and damp microhabitat. Survival is also affected by the availability of prey. There are additional factors that may influence survival of the 3SS. For example, changes in weather patterns resulting in high volume precipitation events and flash floods may wash salamanders out of suitable habitat or erode habitat, thereby negatively impacting the survival of the 3SS. Further impacts to survival are discussed below in the Chapter 3: Influences to Viability.

Dispersal

As discussed in section 2.3 Life History & Ecology, slender salamanders are thought to have small home ranges and be highly sedentary. There is no information available on the dispersal distances of the 3SS species. However, the maximum distances traveled by other species of slender salamanders such as the Pacific slender salamander (*Batrachoseps pacificus*) and the California slender salamander is 3.0–18.3 m (9.8–60.0 ft; Hendrickson 1954, p. 10; Anderson 1960, p. 369; Cunningham 1960, p. 96). The 3SS may need to travel to participate in communal nesting or to find mates. In order for dispersal to be successful, there must be connected aquatic and riparian habitats that contain sufficient prey and cover objects for refugia to allow juveniles or adults to move across the landscape, rest, forage, find mates, and begin breeding. The 3SS have patchy distribution and there may be barriers to dispersal between areas of suitable habitat. Barriers to dispersal for the 3SS may include roads, ground disturbance such as construction or trampling, and a lack of surface water or riparian habitat to act as corridors.

Fecundity

Not much is known about the reproduction of the 3SS. In general, lungless salamanders (family: Plethodontidae) produce one clutch annually. As discussed above, the clutch size of the Kern Plateau salamander ranges from 3–6 in a laboratory setting (Wake *et al.* 2002, p. 1026). The clutch sizes of the relictual slender salamander and the Kern Canyon slender salamander are unknown. However, visual counts of the eggs within gravid relictual slender salamanders indicate they carry between 16–22 eggs (E. Jockusch *in litt.* 2021a, p. 2; E. Jockusch *in litt.* 2021b, p. 4). Many of the individual needs of the 3SS are expected to influence fecundity of the species including availability of suitable aquatic and riparian habitats, cover objects for refugia, small invertebrate prey, and mates.

Abundance

While we do not have population estimates or a robust understanding of the abundance of the 3SS, many of the individual needs identified in the previous section of this SSA Report are expected to influence abundance. A variety of factors may regulate the numbers of 3SS in each geographic group. These factors may be density-dependent (e.g., habitat quality, habitat abundance) or density-independent (e.g., climate). The 3SS require sufficient habitat to allow population sizes large enough to recover from harmful events such as storms, droughts, or fires (environmental stochasticity). We discuss the potential impacts of such factors below, but we lack information regarding the amount of habitat and resulting population size that a single population would require to minimize such risks. Small populations may also be at risk due to demographic stochasticity (chance variations from optimal sex ratios or in reproductive output), or from Allee effects (in which individual fitness is reduced as population/geographic group size decreases) and the inability to encounter mates (Lande 1998, pp. 353, 357; Møller and Legendre 2001, pp. 27, 31–33).

2.6 Species Needs

At the species level, we assess the redundancy and representation of the 3SS to better understand the viability of the species. Redundancy is the ability of a species to withstand catastrophic events and representation is the ability of a species to adapt to changing environmental conditions. Viability is defined as the ability of a species to sustain populations in natural ecosystems and/or human modified ecosystems over time. Using the SSA framework, we describe the 3SS' viability by characterizing the status of each species in terms of its resiliency, redundancy, and representation (3Rs).

Redundancy

Redundancy refers to the ability of species to withstand catastrophic events (such as a destructive natural event or episode involving many geographic groups). Redundancy is about spreading the risk and can be measured through the duplication and distribution of populations/geographic groups or meta-populations across the range of the species. The greater the number of populations/geographic groups a species has distributed over a larger landscape, the better it can withstand catastrophic events. Catastrophic events that could impact the 3SS include fires that burn large areas at high severity, extreme drought, and excessive precipitation. In this SSA Report, we evaluate the redundancy of the 3SS by considering the number and distribution of sites occupied by each species in relation to the scale of catastrophic events that are likely to occur, such as the average size of fires in the region. Forests in the western U.S. have experienced an eightfold increase in the annual area burned at high severity (Parks and Abatzoglou 2020, p. 4). The average size of fires that have occurred in the Sierra Nevada over the past 30 years is 1,400 ha (3,459 ac) (Safford and Stevens 2017, p. 8) with 30 to 35 percent of the burn area at high severity (Safford and Stevens 2017, p. 8). During 2020, a total of 76,416 ha (188,828 ac) burned in the southern Sierra Nevada within Tulare and Kern Counties (NWCG 2021, unpaginated). As slender salamanders have limited dispersal, it is unlikely the 3SS are able to disperse to survive catastrophic events such as fire burning at high severity. Implications of catastrophic events are discussed in more detail in Chapter 3: Influences to Viability.

Representation

Representation refers to the extent to which multiple populations occupy areas of the species' range with differing characteristics, thereby potentially maintaining genetic variations and adaptations to those characteristics that could help the species adapt to future changes. Representation is measured by the breadth of environmental and genetic diversity within and among geographic groups of the 3SS. In the absence of genetic data for the 3SS, the breadth of environmental diversity is used as the measure of representation for the 3SS in this SSA Report. In general, the 3SS are narrow endemics and do not have broad ranges that encompass large environmental variability. However, each of the 3SS occurs over a range of different elevations (relictual slender salamander: 1,219–1,920 m (4,000–6,300 ft), Kern Canyon slender salamander: 451–1,676 m (1,480–5,500 ft), Kern Plateau salamander: 1,434–2,804 m (4,705–9,200 ft)). Due to the differences in climate found throughout the range of elevation occupied by each species, the 3SS are active on the surface during different seasons. These differences in climatic conditions and temporal behaviors may indicate genetic variability between geographic groups, which may help the 3SS adapt to future environmental variability.

Chapter 3: Influences to Viability

In this section, we evaluate the significant past, current, and future influences that are impacting the resiliency, redundancy, and representation of the 3SS. The following influences impact individual needs, population/geographic group needs, or species needs, ultimately affecting the viability of the species. We found no information on predation of the 3SS; thus, we do not expect predation to occur above natural levels for the species.

3.1 Roads

There are numerous county roads and U.S. Forest Service (USFS) roads throughout the range of the 3SS. Roads may alter seeps, springs, and drainages and reduce microhabitat features such as soil moisture and cover objects, especially during road construction or maintenance projects (Marsh and Beckman 2004, pp. 1889–1890; Clipp and Anderson 2014, p. 2690). Hydrologic effects are likely to persist for as long as the road remains a physical feature altering flow routing, often long after abandonment and revegetation of the road surface. Additionally, undersized or impaired culverts can degrade salamander habitat by flooding areas, changing stream dynamics, or rerouting water such that it is no longer available to salamanders (Anderson *et al.* 2014, pp. 278–279). Roads can also act as barriers to movement and effectively isolate populations (Marsh *et al.* 2005, pp. 2006–2007). Furthermore, motor vehicle strikes may cause direct mortality of salamanders. However, because slender salamanders are sedentary and non-migratory, slender salamanders are considered to be at low risk of direct mortality by vehicle strikes (Brehme *et al.* 2018, p. 924).

Most notably, State Route 178 is a heavily trafficked road that passes through the historical range of the relictual slender salamander and the range of the Kern Canyon slender salamander in the Lower Kern River Canyon. Construction of State Route 178 in 1933 and subsequent repair, maintenance, and widening of the road altered drainages and degraded habitat occupied by the salamanders (Lannoo, pp. 688–693; USFS 2011a, p. 39). Construction associated with State Route 178 may have contributed to the extirpation of the relictual slender salamander from the Lower Kern River Canyon (Lannoo, pp. 688–690; USFS 2011a, p. 39). The Kern Canyon slender salamander may have also been extirpated from some sites in the Lower Kern River Canyon due to degradation of habitat from construction and enhancement of State Route 178 (Lannoo, p. 693; USFS 2011a, p. 39).

Additionally, road construction associated with timber harvest in the National Forests has historically degraded habitat for the relictual slender salamander and the Kern Plateau salamander. On Breckenridge Mountain in the early 1980s, a USFS logging road was rerouted through a portion of a seep occupied by the relictual slender salamander. The construction considerably modified the structure and hydrology of the seep and the number of relictual slender salamanders found at the site was reduced for the following 20 years (Jennings and Hayes 1994, p. 24; Jockusch *et al.* 2012, p. 18). The current land management plans for the Sequoia and Inyo National Forests outline standards to minimize the impact of existing roads on natural hydrologic flow and the impact of the construction of roads on wetlands, and to decommission and rehabilitate low priority roads (USFS 2004, p. 63, 65; USFS 2019a, p. 1555). Historically, road construction and expansion has impacted habitat occupied by the 3SS through degradation of seep and spring habitat. Roads may currently be limiting dispersal of the 3SS in areas of high road density. Additionally, altered hydrology caused by existing roads and road repair and maintenance activities will likely continue to impact the habitat of the 3SS.

3.2 Recreation

Sequoia and Inyo National Forests offer a variety of recreational activities for the public, including off-highway vehicle trails, hiking, and camping. Sequoia National Forest alone receives more than one million visitors a year (USFS 2019b, p. 72). Portions of the ranges of the 3SS are considered high-use recreation areas including the Lower Kern River Canyon, within the historical range of the relictual slender salamander and the range of the Kern Canyon slender salamander, and the western Kern Plateau within the range of the Kern Plateau salamander (USFS 2019b; Figure 23, p. 129). Additional portions of the 3SS ranges are considered moderate-use recreation areas including the eastern portion of the Kern Plateau within the range of the Kern Plateau salamander and Breckenridge Mountain within the range of the relictual slender salamander (USFS 2019b; Figure 23, p. 129). Off-highway vehicles frequent trails on the Kern Plateau adjacent to sites occupied by the Kern Plateau salamander. Additionally, off-highway vehicle trails pass by sites occupied by each of the 3SS species: relictual slender salamander sites on Breckenridge Mountain; Kern Canyon slender salamander sites in the Lower Kern River Canyon; and Kern Plateau salamander sites in the Scodie Mountains.

Recreation that results in ground disturbance within occupied habitat may have direct and indirect impacts on the 3SS. Trails that pass through meadows, seep, or springs have the potential to alter hydrology and reduce habitat suitability for the 3SS. Trampling by hikers, bikers, pets, and off-highway vehicles on trails within habitat occupied by the 3SS has the potential to directly kill individual slender salamanders. Additionally, trails adjacent to occupied habitat have the potential to alter hydrology which may result in the loss of wet habitat or increased runoff and sedimentation that may negatively impact water quality and seep and spring habitat (Meadows *et al.* 2008, entire; Sack and da Luz 2003, entire).

Recreation within the National Forests is managed by the current land management plans for Sequoia and Inyo National Forests (USFS 2004, entire; USFS 2019a, entire). For most USFS trails, considerations have been made to determine the environmental impacts of the trails and adjustments have been made to minimize impacts (USFS 2004, pp. 59, 63, 65; USFS 2019a, p. 85). In the Lower Kern River Canyon within the historical range of the relictual slender salamander and the range of the Kern Canyon slender salamander, some areas have been gated off from off-highway vehicles to protect sensitive riparian habitat (USFS 2013, p. 7). In the 1980s, dispersed camping was restricted from some Sequoia National Forest lands within the historical range of the relictual slender salamander and the range of the Kern Canyon slender salamander in the Lower Kern River Canyon, but these lands remain open to off-highway vehicles and foot traffic (USFS 2011a, p. 43). On Breckenridge Mountain in Sequoia National Forest within the range of the relictual slender salamander, dispersed camping is permitted and there is a designated primitive campground. Additionally, illegal user-made off-highway vehicle trails are continually established in the Sequoia National Forest on Breckenridge Mountain within the range of the relictual slender salamander and on the Kern Plateau within the range of the Kern Plateau salamander (USFS 2019c, pp. 109, 113, 115). Recreation may currently be impacting the 3SS in high-use recreation areas through degradation of seep and spring habitat and possibly through direct mortality of individuals from trampling.

3.3 Grazing

Grazing occurs throughout Sequoia and Inyo National Forests and most sites occupied by the 3SS are within grazing allotments. The rangelands of the Sequoia National Forest have been grazed by livestock since the late 1800s (USFS 2019b, p. 5). Grazing and associated infrastructure (water troughs, corrals, loading chutes, and fences) have the potential for direct and indirect impacts to the 3SS. The mesic habitat used by salamanders is often in areas that livestock congregate in to seek shade, cooler bedding, and water (USFS 2011a, p. 45). Livestock can cause direct mortality by laying or stepping on salamanders or the cover objects that salamanders are sheltering under. Grazing can cause erosion of stream channels and can damage and reduce vegetative cover (Kauffman and Krueger 1984, pp. 431–434; Armour *et al.* 1994, pp. 9–12). Loss of vegetative cover from grazing has the potential to lower groundwater tables and summer flows (Kauffman and Krueger 1984, pp. 431–434; Armour *et al.* 1994, pp. 9–12). To provide water for livestock, water is sometimes diverted from springs and streams, limiting the extent of wet in-channel and riparian habitat. Formerly perennial seeps, springs, and streams may become intermittent or dry due to loss of water storage capacity in the aquifers that formerly sustained them. Furthermore, heavy grazing can alter vegetative species composition and contribute to expansion of lodgepole pine (*Pinus contorta*) into areas that were formerly treeless (Ratliff 1985, pp. 33–36; Cole and Landres 1996, p. 171). Additionally, loss of vegetation cover caused by grazing and trampling can increase soil temperature and reduce soil moisture, thereby impacting the availability of suitable microclimate conditions for the 3SS (Riedel *et al.* 2008, entire). Historically, grazing has severely degraded 3SS habitat at the bottom of narrow ravines where grazing is concentrated and salamanders are found near the surface in higher densities (Lannoo 2005, pp. 688–693; USFS 2011a, p. 44).

Grazing within the ranges of the 3SS has been reduced since the early 1900s when the Forest Reserves, the precursor to the USFS National Forests, were established. Grazing is now managed by the current land management plans for Sequoia and Inyo National Forests (USFS 2004; USFS 2019a). The plans include management strategies that limit grazing in fens, meadows, and riparian areas (USFS 2004, pp. 65–66; USFS 2019a, p. 85) and may therefore benefit the 3SS. Specific measures include inventorying of fens prior to re-issuing of grazing permits to ensure desired species richness and implementing grazing limitations or suspensions necessary in the event of habitat degradation. In the last 20 years, some riparian areas within the Lower Kern River Canyon and on Breckenridge Mountain have been fenced off to exclude livestock. Additionally, some sites occupied by the 3SS within grazing allotments are in incidental use areas and may not be accessible to livestock because of rocky terrain. Grazing may be currently impacting the 3SS through localized effects to aquatic and riparian habitat at sites that are accessible to livestock within grazing allotments. Grazing also has the potential to result in direct mortality of salamanders. The impact of grazing on the 3SS is expected to be more severe within habitat in narrow canyons.

3.4 Timber Harvest

Timber harvest including commercial harvest, thinning treatments to reduce risk of fire, and snag removal post-fire or beetle-kill events has the potential to impact the 3SS through direct mortality and indirect impacts to habitat. Direct mortality may result from timber harvest involving the use of heavy equipment within habitat occupied by the 3SS. Heavy equipment used for timber harvest may crush salamanders that are active on the surface. Aquatic and riparian habitats are impacted by timber harvest that takes place within the watershed due to increased runoff, erosion, and sedimentation, and the resulting changes in water flow, water quality, and stream morphology (Chamberlin 1982, entire). Additionally, timber harvest has the potential to indirectly affect the 3SS through construction of new roads to support timber harvesting and bring in large equipment, removal of shade structure that is important for the thermal regulation of the environment and suitable microclimate conditions for the 3SS, and removal of woody cover objects that salamanders need for refugia (Duvall and Grigal 1999; entire). No studies have focused on the effects of timber harvest on the 3SS or within the range of the 3SS, but several studies have found that the abundance of terrestrial salamanders decreases in areas that have been harvested for timber (Petranka *et al.* 1993, entire; deMaynadier and Hunter 1995, entire; Dupuis *et al.* 1995, entire; Ash 1997, entire; Herbeck and Larsen 1999, entire; Knapp *et al.* 2003, entire; Homyack *et al.* 2011, entire).

The majority of forest roads in the National Forests of the Sierra Nevada were built between 1950 and 1990 to support major increases in timber harvest (USFS 2001, p. 443). Most of the impact of timber harvesting and associated road development on habitats within the National Forests of the Sierra Nevada took place during the expansion period in the latter half of the 20th century. Over the past 20 years timber harvest in the Sequoia National Forest has decreased substantially. Timber harvest in the National Forests within the range of the 3SS is managed by the current land management plans for Sequoia and Inyo National Forests (USFS 2004, entire; USFS 2019a, entire). Current forest standards and guidelines outline timber harvest practices that maintain minimum forest density requirements and increase retention of down logs and coarse woody debris thereby possibly benefiting the 3SS by contributing to the availability of refugia. Current forest standards and guidelines provide protections for riparian areas, such as maintaining buffers during timber and vegetation management activities. Furthermore, riparian areas are protected by mechanical equipment buffers and are generally not harvested. However, fire suppression has resulted in increased conifer density and decreased riparian herbaceous vegetation in riparian areas, which may lead to more timber management in riparian areas in the future (USFS 2019c, pp. 109, 112, 115).

In recent years, large tree mortality events due to drought conditions and beetle outbreaks have occurred in the Sequoia National Forest and the Inyo National Forest (Preisler *et al.* 2017, p. 166). The estimated number of dead trees in the Sequoia National Forest has increased annually for the past decade (USFS 2018, entire). It is likely that tree mortality will continue due to worsening drought conditions that will continue to weaken trees and increase susceptibility to bark beetles and disease, necessitating increased thinning to reduce the threat of fire in the National Forests (Millar and Stephenson 2015, pp. 823–826; Young *et al.* 2017, pp. 78, 85). However, tree mortality is expected to be lower in wetter riparian areas along the seeps, springs, and streams that provide habitat for the 3SS.

Timber harvest has occurred near sites occupied by the relictual slender salamander and the Kern Plateau salamander. The Revised Draft Land Management Plan for the Sequoia National Forest identifies 32,276 ha (79,755 ac) as suitable for timber production (USFS 2019b, p. 85), and the Revised Land Management Plan for the Inyo National Forest classifies 30,276 ha (74,814 ac) as suitable for timber production (USFS 2019a, p. 159). Areas classified as suitable for timber harvest encompass 6.3 percent of the estimated historical range of the relictual slender salamander, 0.5 percent of the estimated range of the Kern Canyon slender salamander, and 5.8 percent of the estimated range of the Kern Plateau salamander. Although impacts to habitat from timber harvest have the potential to for population-level effects on the 3SS, at present the best available information indicates current levels of timber harvest are not adversely affecting the 3SS. However, the legacy effects of timber harvest activities such as roads and modified hydrology may continue to have localized impacts on the habitat condition of some sites occupied by the 3SS.

3.5 Hazard Tree Removal

In areas not suitable for timber production in the National Forests, tree removal may occur for other purposes such as hazard tree removal as outlined by the current land management plans of the Sequoia and Inyo National Forests (USFS 2004; USFS 2019a). Dead and dying trees and living trees that are deemed a risk to people or property may be removed extensively along roads and trails and within wildfire areas (USFS 2019a, p. 162). Hazard tree removal within the ranges of the 3SS is unlikely to result in salamander mortality as it does not generally involve the use of heavy equipment. Hazard tree removal often takes place along existing roads and trails and thereby does not necessitate the construction of additional forest roads. Therefore, hazard tree removal likely has less impact on salamander habitat than timber harvest. Hazard tree removal may reduce fuel loads and thereby reduce the risk of high severity wildfire within habitat occupied by the 3SS. As many of the sites occupied by the 3SS are near roads and trails, hazard tree removal is expected to occur at some of these sites within habitat occupied by all three species. Hazard tree removal may result in localized effects on the habitat of the 3SS where removal of trees occurs in proximity to habitat occupied by the 3SS and results in modification of seep, spring, or creek margin habitat.

3.6 Infrastructure Development

Infrastructure development has had the greatest historical impact on habitat occupied by the relictual slender salamander and the Kern Canyon slender salamander. Damming of the Lower Kern River to form Lake Isabella in 1953 flooded areas in the Lower Kern River Canyon and prompted construction and expansion of State Route 178 and ongoing recreation development along the Lower Kern River. Flumes, tunnels, roads, and trails associated with the operation of the Kern River No. 1 hydroelectric project and two placer mining claims are also present along the Lower Kern River within the historical range of the relictual slender salamander and the range of the Kern Canyon slender salamander (USGS 2021a, pp. 1–3; USGS 2021b, pp. 1–3). Additionally, ongoing maintenance is required for utility infrastructure including communication sites in the Lower Kern River Canyon and on Breckenridge Mountain and transmission lines and an electrical subunit in the Lower Kern River Canyon within the Sequoia and Inyo National Forests. Maintenance of utilities can often be carried out from roads or already disturbed corridors where the 3SS are not expected to be found. However, it may be necessary for utility crews to access off-road sites where the salamanders are found to replace or perform work on power poles. Equipment used for utility maintenance may cause direct mortality of salamanders by crushing salamanders that are active on the surface or damage habitat by altering seeps and springs. Infrastructure development associated with recreation, roads, hydroelectric projects, and utility maintenance has the potential to cause periodic habitat disturbance to sites occupied by the relictual slender salamander and the Kern Canyon slender salamander with impacts likely concentrated within the Lower Kern River Canyon.

There has been discussion of future large infrastructure projects in the Lower Kern Canyon and on the eastern slope of the Scodie Mountains. Discussions have included a proposed reservoir that would potentially impact the Kern Canyon slender salamander and a wind energy development project in proximity to the estimated range of the Kern Plateau salamander. In June 2020, Premium Energy Holdings LLC filed an application (P-15035) to the Federal Energy Regulatory Commission for a preliminary permit to assess options for the Isabella Pumped Storage Project. The application was accepted for filing in November 2020. Three alternative sites for construction of a new reservoir were detailed in the application, including a site along Erskine Creek. The area proposed for flooding along Erskine Creek does not include known sites of the Kern Canyon slender salamander. However, construction of the proposed Erskine Reservoir and associated infrastructure development would take place close to occupied sites and within potentially suitable habitat for the Kern Canyon slender salamander. Construction and increased traffic in the area would likely have negative impacts on the Kern Canyon slender salamander. Additionally, a reservoir on Erskine Creek could alter water flow and cause floods or water shortages, resulting in loss of habitat for the Kern Canyon slender salamander along Erskine Creek.

A wind energy development project on the eastern slope of the Sierra Nevada could cause habitat alteration and habitat loss if construction occurred within suitable habitat of the Kern Plateau salamander. The potential impacts of the wind energy development outlined by the Desert Renewable Energy Plan are currently limited to a small area adjacent to the Scodie Mountains that does not include aquatic or mesic habitat or areas within the range of the Kern Plateau salamander (USBLM 2016, figure 2, p. 3). Additionally, habitat occupied by the Kern Plateau salamander on the Scodie Mountains is within the Kiavah Wilderness, which is not subject to wind energy development. Implementation of any of these proposed projects within the suitable habitat of the 3SS may impact the species. However, there is no available information to suggest that infrastructure development associated with these projects will take place within suitable habitat for the 3SS.

3.7 Small Population Size

The populations of most species fluctuate naturally, responding to various factors such as weather events, disease, and predation. These factors have a relatively minor impact on a species with large, stable local populations and a wide and continuous distribution. However, populations that are small, isolated by habitat loss or fragmentation, or impacted by other factors are more vulnerable to extirpation by natural, randomly occurring events (such as stochastic weather events), and to genetic effects that plague small populations, collectively known as small population effects (Purvis *et al.* 2000, p. 3). These effects can include genetic drift, founder effects (over time, an increasing percentage of the population inheriting a narrow range of traits), and genetic bottlenecks leading to increasingly lower genetic diversity, with consequent negative effects on adaptive capacity and reproductive success (Keller and Waller 2002, p. 235). The 3SS have persisted historically with narrow and patchy distribution and therefore, likely small populations. However, because the relictual slender salamander has few extant sites within a small range, stochastic events may be catastrophic for the species. We do not have specific information on the population sizes or population trends of the 3SS. In the absence of more information on the population sizes of the 3SS, small population size is not included as a threat in our conceptual model or our assessment of current or future conditions.

3.8 Fire

Fire is a natural ecological process, and fires within the natural range of variation are generally considered beneficial to ecosystems in the Sierra Nevada. Over the long term, small, fires that burn mostly at low severity recruit essential habitat elements such as fire-adapted plant species, mosaics of vegetation, and nutrient cycling. In contrast, very large fires with patches that burn at high severity, outside the natural range of variation, can remove forest cover and fragment habitat over large areas and long time periods.

Current conditions within the ranges of the 3SS may contribute to ongoing fire risk. Years of fire suppression in forests of the western United States have led to greater canopy cover from small and medium trees, higher biomass density, and more surface fuels (Parks and Abatzoglou 2020, p. 4). Historically, the mean fire return interval within the Sierra Nevada was 11–16 years (the range of fire return intervals for yellow pine forest and moist mixed conifer forest was 5–80 years) with 5 to 15 percent of burn area at high-severity and the mean fire size was small between 200 to 400 ha (494–988 ac) (Safford and Stevens 2017, p. 7). Fire suppression over the last 100 years combined with extended droughts has led to increased fuel loads and changes in fire behavior with larger, more severe fires, and longer wildfire seasons in recent years (Miller and Safford 2012, p. 41; Mallek *et al.* 2013, p. 1; Safford and Stevens 2017, pp. v–vi; Nigro and Molinari 2019, p. 20). From 1984 to 2017, forests in the western U.S. have experienced an eightfold increase in the annual area burned at high severity (Parks and

Abatzoglou 2020, p. 4). Fires that have occurred during this period within the ranges of the 3SS are shown below in Figure 8. Current fire return intervals within the estimated ranges of the 3SS are 56–81 years (USFS 2011b, unpaginated). Additionally, the mean size of fires in the Sierra Nevada over the past 30 years is approximately 1,400 ha (3,459 ac) with 30 to 35 percent of the burn area at high severity (Safford and Stevens 2017, p. 8). The trend in increasing annual area burned at high severity is expected to continue as a result of increasingly warmer and drier fire seasons due to climate change (Parks and Abatzoglou 2020, p. 6).

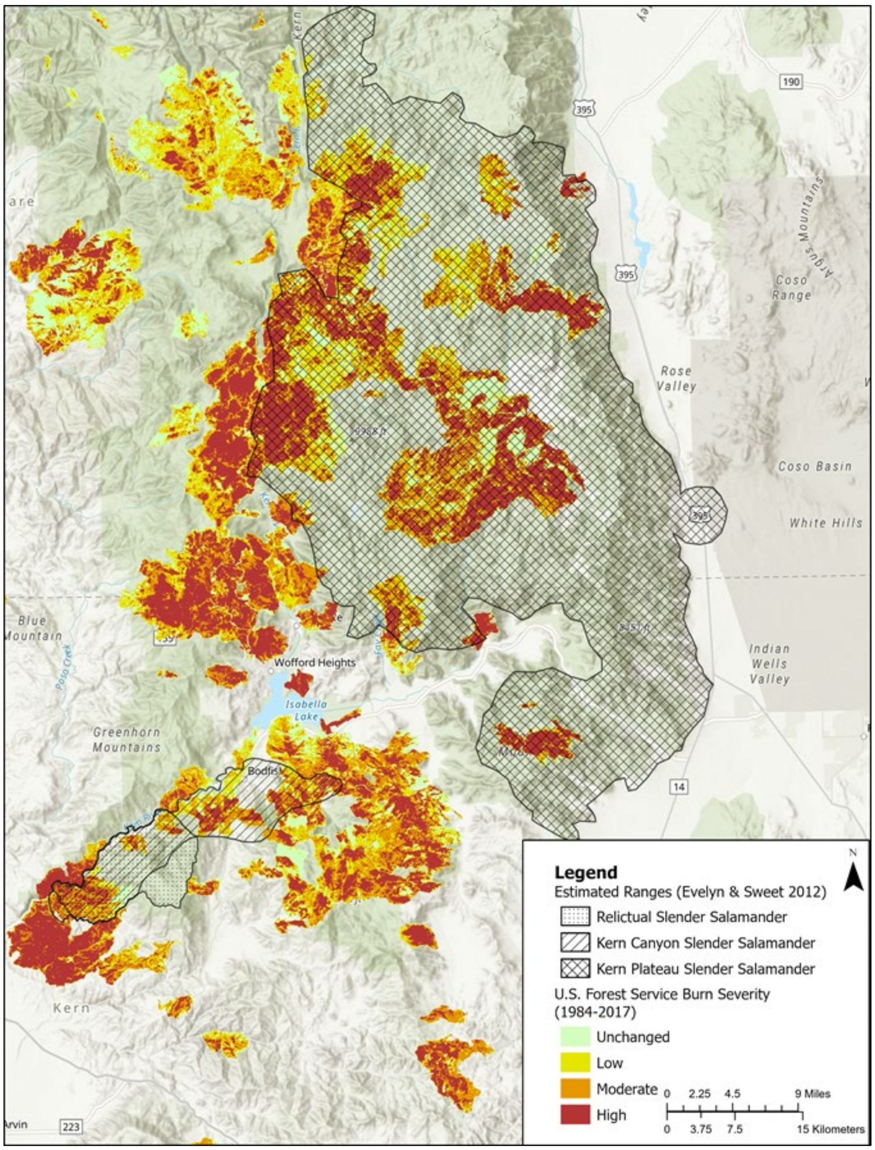


Figure 8. Wildfire location and severity from 1984–2017 within the estimated ranges of the relictual slender salamander, Kern Canyon slender salamander, and Kern Plateau salamander (Evelyn and Sweet 2012). The wildfire severity data are from the USFS Pacific Southwest Region database for large fires since 1984 (https://www.fs.usda.gov/detail/r5/landmanagement/gis/?cid=STELPRDB5327833). Unchanged burn severity is defined as areas of surface fire with no identified change in canopy cover or vegetation, low severity fire is defined as areas of surface fire with little change in cover and little mortality of the structurally dominant vegetation,

moderate severity is defined as a mixture of effects on the structurally dominant vegetation, and high severity is defined as areas where the dominant vegetation has high to complete mortality.

Little is known about the impact of fire on terrestrial salamanders and their habitat. In general, riparian areas burn less frequently and at lower severity. However, fires may have large impacts on the 3SS due to their low mobility and small range sizes. Fires that burn at low and moderate severity and occur at low elevations during the dry summer, when the salamanders are most likely sheltering in underground burrows, may have minimal effects. However, at higher elevations salamanders are thought to be active on the surface during the summer, and fires that burn at low to moderate severity may result in mortality of salamanders. Throughout the range of the 3SS, high severity fires are especially likely to result in direct mortality to both salamanders on the surface and those sheltered underground, due to radiating heat and loss of soil moisture, as temperatures at the soil-litter interface can reach 482–648 °C (900–1,200 °F) (Sampson 1944, p. 62). Individuals more than a few inches below the soil surface may survive the high severity fire but will then have reduced or no surface cover and reduced or no invertebrate prey community until the landscape recovers. Additionally, because high severity fire can reduce canopy cover and remove insulating groundcover soil, temperatures in the top 10 centimeters (3.9 in) of soil in recently burned stands can be 5−10 °C (9−18 °F) higher than in late successional stands, affecting the availability of suitable microclimate conditions for the 3SS following fires (Liu *et al.* 2005, p. 8; Treseder *et al.* 2004, p. 1831). Furthermore, fire residence time may also influence the impact of fires on the 3SS as fires that burn for a long time may result in more direct mortality of salamanders than fires that move through the area quickly. Post-fire increases in soil temperature can be accompanied by long-term decreases in soil moisture and increases in soil water repellency, which may result in dry conditions that are intolerable for the 3SS (DeBano 2000, p. 196; Holden *et al.* 2013, p. 39). After fires occur, habitat may also be degraded by increased soil erosion, runoff, and sedimentation (Benavides-Solorio and MacDonald 2001, entire; Robichaud and Waldrop 1994, entire; Spigel and Robichaud 2007, entire). More research is necessary to better understand the relationships between wildfires, salamanders, and their habitat.

Large, catastrophic fire cannot be completely addressed by regulatory mechanisms. However, some management actions can reduce the potential severity or size of wildfires (Agee and Skinner 2005, entire; Safford *et al.* 2009, entire). Fuel reduction treatments, such as prescribed fire and mechanical thinning, can reduce the severity of a future fire (Agee and Skinner 2005, entire; Safford *et al.* 2009, entire). We have limited understanding of the trade-off between impacts from conducting fuels treatments to prevent or reduce future fires and impacts from fires themselves to salamanders and their habitat (see sections on Timber Harvest and Hazard Tree Removal above). Fuels treatments that are carried out within habitat occupied by the salamanders may cause ground disturbance or result in modification of seep, spring, or creek margin habitat. Two species of terrestrial salamanders in the Sierra Nevada, the Sierra ensatina (*Ensatina eschscholtzi platensis*) and the gregarious slender salamander (*Batrachoseps gregarius*), were found to persist after prescribed fire applications were conducted in the spring (Bagne and Purcell 2009, entire). However, fuel reduction treatments may not prevent catastrophic damage in an extreme fire event (Peterson *et al.* 2003, p. 3).

Additionally, if a wildfire becomes a threat to infrastructure fire retardant may be used in areas occupied by the 3SS that are in proximity to development in the Lower Kern River Canyon, Breckenridge Mountain, and the Kern Plateau. Fire retardant chemicals contain nitrogen compounds and surfactants (chemical additive used to facilitate application). Laboratory tests have shown that surfactants or ammonia byproducts can cause mortality in fishes and aquatic invertebrates (Hamilton *et al.* 1996, pp. 132-144); similar effects are possible in amphibians. Calfee and Little (2003, pp. 1529-1530) report that southern leopard frogs (*Rana sphenocephala*) and boreal toads (*Bufo boreas*) are more tolerant than rainbow trout (*Oncorhynchus mykiss)* to fire retardant chemicals; however the acute toxicity of some compounds is enhanced by ultraviolet light, which may harm amphibians at environmentally relevant concentrations. Therefore, if fire retardant chemicals are dropped in or near 3SS habitat, they could have negative effects on individuals. Exposure of water bodies to fire retardant chemicals can also disrupt trophic systems by impacting algae and invertebrates (McDonald *et al.* 1996, pp. 62, 69, 71; Finger *et al.* 1997, pp. 136–137), which may be important food sources for the 3SS. Bioaccumulation of retardant chemicals from affected food resources might also impact amphibians (Hale *et al.* 2002, p. 732; Pilliod *et al.* 2003, p. 175). Furthermore, post-fire restoration involving large machinery has the potential to impact 3SS habitat through ground disturbance or result in direct mortality of salamanders that are active on the surface. Fire and management activities related to fire suppression and post-fire restoration may affect the 3SS through degradation of aquatic, mesic, and riparian habitats, loss of suitable cool and damp microclimates, loss of prey, and possibly direct mortality of individuals. Because of the small ranges of the 3SS, entire geographic groups could be extirpated by fire, thus reducing species redundancy, and potentially causing loss in ecological representation.

3.9 Climate Change

Climate change is the change in the mean or variability of one or more measures of climate that persist for an extended period, whether the change is due to natural variability or human activity (IPCC 2013, p. 1450). The climate has been warming at an unprecedented rate since the 1950s, and is likely to continue to increase, causing not only warmer conditions but also an increase in the intensity of storms (IPCC 2013, p. 4). The recent changes in climate are attributed to increased greenhouse gas emissions in the atmosphere, which are likely to continue to increase (IPCC 2013, pp. 4, 11–12, 19).

In California, the annual average temperatures have increased by about 0.8 °C (1.5 °F) since 1895 (Kadir *et al.* 2013, p. 38). Additionally, extreme heating events have increased throughout the state (Kadir *et al.* 2013, p. 48). Specifically, in the Sierra Nevada region, mean annual temperatures have generally increased by around 0.5–1.4 °C (1.0–2.5 °F) over the past 75–100 years (North 2012, p. 25). These trends are projected to continue, by all modern climate models, and to accelerate during coming decades. Within the Sierra Nevada, changes in climate are expected to vary in magnitude across the region with quicker warming trends and changes in precipitation at highest elevations (Dettinger *et al.* 2018, p. 5). The annual mean temperatures across the region are projected to warm by 1.0 °C (2.0 °F) by 2039 and by 2.5 °C (4.5 °F) by 2040–2069 as predicted by the average of ten climate models (Abatzoglou 2013, entire; Pierce *et* *al.* 2013, p. 844; Hegewisch *et al.* 2018, unpaginated). Additionally, in the summer months of June, July, and August mean temperatures are projected to increase by 3.3 °C (5.9 °F) by 2040-2069 in the Sierra Nevada region (Pierce *et al.* 2013, p. 842; Hegewisch *et al.* 2018, unpaginated).

With increasing temperatures and less snowfall, salamanders that occur at high elevations (i.e., relictual slender salamander on Breckenridge Mountain and Kern Plateau salamander on the Kern Plateau) may experience extended periods of favorable conditions and may increase the time they spend on the surface until climatic conditions approach and surpass physiological limits. While temperature increases at high-elevation may be within the thermal tolerances of the 3SS, temperature increases at low-elevation may exceed salamander tolerances (Caruso and Rissler 2019, p. 12). At higher temperatures salamanders must increase feeding frequency to maintain energy balances (Huey and Kingsolver 2019, entire). If salamanders are not able to increase feeding frequency because temperatures on the surface exceed physiological limits or if prey are not available in sufficient quantities then increased metabolism caused by temperature increases may have geographic group-level demographic consequences such as decreased body sizes and growth rates (Caruso *et al.* 2014, p. 1757; Muñoz *et al.* 2016, p. 8744). Reductions in body size could lead to delayed maturity or reduced fecundity, ultimately leading to geographic group declines.

Future precipitation is predicted to vary less than temperature; long-term mean annual changes may be no more than plus or minus 10–15 percent of current totals (Dettinger *et al.* 2018, p. 5). However, precipitation extremes (both as deluge and drought) are expected to increase markedly under climate change (Dettinger *et al.* 2018, p. 5). As a result of projected warming, the transition from rain to snow during a storm is expected to rise by 457–914 m (1,500–3,000 ft) (Dettinger *et al.* 2018, p. 21). Sierra Nevada snowpacks will be unlikely to form below about 1,829 m (6,000 ft) elevation and snowpacks will be reduced by more than 60 percent across most of the Sierra Nevada by the end of the century (Dettinger *et al.* 2018, p. 21). Losses of snowpack may be even greater due to feedback loops with warming trends causing snow cover losses, and snow cover losses resulting in warmer land surfaces and thus enhanced warming trends in turn (Dettinger *et al.* 2018, p. 5). The higher snow-dominated elevations from 2,000–2,800 m (6,560–9,190 ft) will be the most sensitive to temperature increases (Point Blue 2011, p. 23). Seeps and springs fed by snowmelt may dry out or be more ephemeral during the non-winter months (Point Blue 2011, p. 24). This pattern could influence groundwater transport, and seeps and springs may be similarly depleted, leading to lower water levels and decreased area and hydroperiod (i.e., duration of water retention) to support suitable habitat for the 3SS. More precipitation falling as rain and increased early snow melt is also expected to result in greater winter streamflow and floods that may impact 3SS habitat by causing erosion of salamander habitat in stream margins (Dettinger *et al.* 2018, p. 5).

As a result of warmer temperatures, with corresponding tendencies for more rainfall, less snowfall, and earlier snowmelt, water will tend to exit bodies of surface water at high elevations earlier in the year (Harpold *et al.* 2015, entire). Additionally, the water that remains in habitats will evaporate and be used by plants more quickly due to warmer temperatures and increased evapotranspiration rates, so that by summer, soil moisture will be low (Harpold *et al.* 2015, entire). The average historical climatic water deficit, or the additional water that would have evaporated or transpired had it been present in the soils given the temperature, from 1990 to 2010 in the southern Sierra Nevada within the 3SS range is 840.6 mm (33.1 in) (Hegewisch *et al.* 2018, unpaginated). By 2039 the twenty-year average climatic water deficit is projected to increase by 2.0–69.1 mm (0.1–2.7 in) and by 2069 the twenty-year average is projected to increase by 75.6–200.9 mm (3.0–7.9 in) (Hegewisch *et al.* 2018, unpaginated). Furthermore, total soil moisture in the summer is expected to decrease in areas at high elevation on Breckenridge Mountain and the Kern Plateau (Hegewisch *et al.* 2018, unpaginated).

Both the individual and geographic group needs of the 3SS will likely be impacted by climate change, but the full extent of impacts that climate change may have on terrestrial salamanders is poorly understood. Changing climatic conditions may have direct impacts on salamander physiology, survival, reproduction, recruitment, and population growth. Additionally, climate change may have indirect impacts on the 3SS including changes in habitat quantity and quality, and prey distribution and abundance. For the 3SS to successfully forage and meet their energy requirements, temperature and moisture conditions must be suitable in adequate durations. Reduced sedimentary moisture may impact the survival of the 3SS by further constraining the time that the salamanders can be active on the surface. Reduced ambient moisture may also decrease the amount of suitable microhabitat for breeding and rearing as the salamanders are thought to need cool and damp protected microhabitat for egg laying. Additionally, warmer, and drier fire seasons due to climate change are predicted to result in more frequent fires burning at high severity (Parks and Abatzoglou 2020, entire). Overall, the Sierra Nevada region is likely to be much drier in the future and the climatic water deficit will increase over the next 50 years due to climate change (Dettinger *et al.* 2018, p. 23; Hegewisch *et al.* 2018, unpaginated). Climate change is expected to affect the 3SS through degradation of seep and spring habitat, loss of suitable microhabitat conditions, and possibly, reduction in survival and fecundity of salamanders with risk varying across habitat type and elevation.

3.10 Disease

Another potential threat to the 3SS is the pathogenic chytrid fungus *Batrachochytrium dendrobatidis* (Bd). Other species of slender salamanders are known to be susceptible to chytrid fungal infection and the fungus is present in wild populations of the California slender salamander and the Santa Lucia Mountains slender salamander (*Batrachoseps luciae*; Weinstein 2009, entire; Cowgill *et al.* 2021, entire). However, wild populations of the California slender salamander appear to have remained stable with seasonally variable infection rates of chytrid fungus (Weinstein 2009, entire). Similarly, population declines have not been reported for the Santa Lucia Mountain slender salamanders and no sick individuals have been found in the wild (Cowgill *et al.* 2021, p. 11). Additionally, Cowgill *et al.* (2021, p. 7) found that Santa Lucia Mountain slender salamanders have symbiotic skin-bacteria that inhibit growth of Bd in laboratory trials. There is no available information indicating the presence of chytrid fungus in the 3SS. However, other amphibian species located in the Sierra Nevada such as mountain yellow-legged frog (*Rana muscosa*) are severely affected by chytrid outbreaks. Different life history traits likely reflect the differences in observed severity of Bd between the California slender salamander and the mountain yellow-legged frog. Cowgill *et al.* 2021 found that Bd infection probability is positively correlated with elevation, intraspecific group size, and proximity to other species (Cowgill *et al.* 2021, p. 6). There is one extant population of mountain yellow-legged frogs on the Kern Plateau that is infected with Bd. However, this population of mountain yellow-legged frogs is approximately 6 km (3.8 mi) away from sites occupied by the Kern Plateau salamander on the Kern Plateau, outside of the dispersal range of the species (CNDDB 2022, unpaginated). Additionally, the newly identified fungal pathogen, *B. salamandrivorans*, which has not been identified in North America but has caused population declines of European salamanders, may be a potential threat to the 3SS (Richgels *et al.* 2016, p. 1). We do not have information to indicate that the 3SS are currently impacted by disease and therefore, we do not include disease in our conceptual model or in our assessment of current or future conditions.

3.11 Collection

We did not find information to suggest that collection of the 3SS for commercial, recreational, scientific, or educational purposes occurs at a level that may impact the species. However, given the narrow range of the 3SS and the limited number of individuals observed, collection for recreational and scientific purposes may be a potential threat to the 3SS. As we do not have more information on collection, we do not include collection as a threat in our conceptual model or in our assessment of current or future conditions.

3.12 Cumulative and Synergistic Effects

The threats discussed above all act independently, but also interact with each other. It is important to assess the impacts of combined threats because there may be new or exacerbated impacts that are not considered when a threat is assessed alone. There are a vast number of ways the combined threats may be interacting with each other, but the SSA Report will only focus on what is currently most relevant to the viability of the 3SS.

Certain factors tend to produce cumulative effects due to the similarity of their impacts. For instance, road construction, recreation, grazing, timber harvest, hazard tree removal, infrastructure development, and post-fire cleanup can all cause ground disturbance and when these threats overlap, they may cumulatively result in considerable degradation of habitat and direct mortality of salamanders. Other threats may act synergistically by increasing the influence of another threat on the viability of the 3SS. For example, climate change is expected to intensify tree mortality and fire, potentially increasing the need for timber harvest and hazard tree removal. At this point in time, it is difficult to determine which threats are causing the most significant stress to any of the 3SS as different geographic groups are likely affected by these threats differently. All these cumulative and synergistic impacts occur currently and are likely to continue. However, the relative impacts may change as the quality and quantity of the 3SS habitat changes overtime. Figure 9 is a conceptual model that includes the threats outlined above and how they may be interacting with the individual and population needs of the species to influence population resiliency.

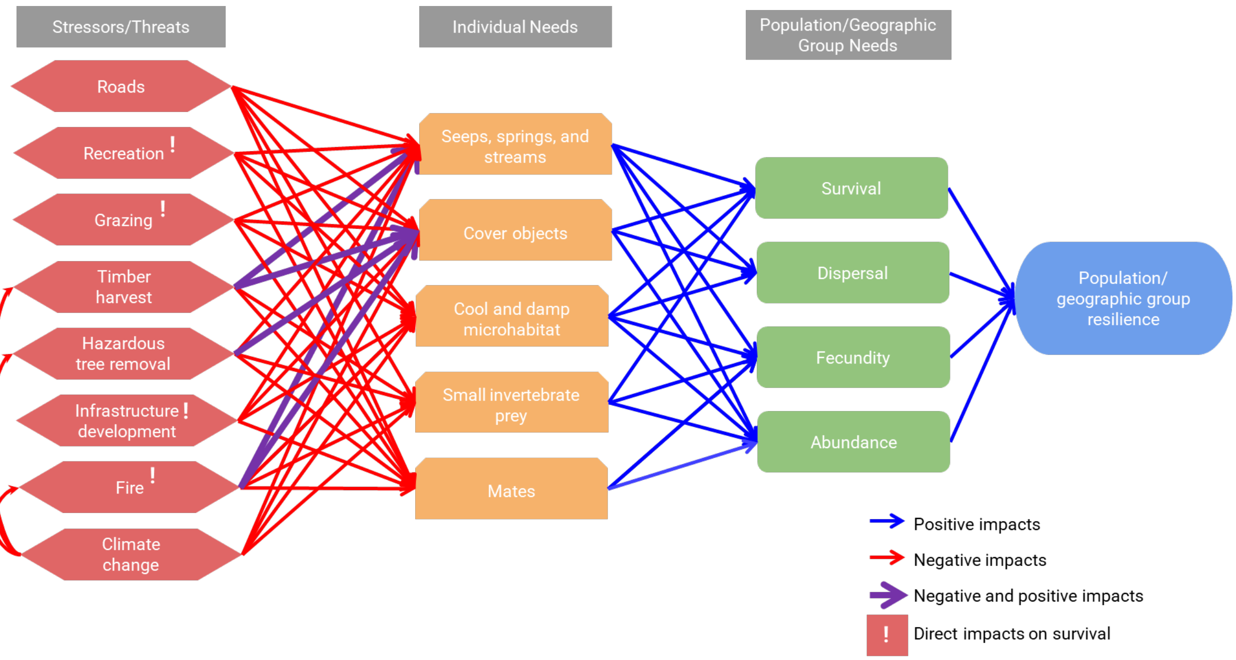


Figure 9: Conceptual Model of the threats identified for the salamander species and how they are interacting with the individual and population needs to impact population/geographic group resiliency. Threats that may cause direct mortality are identified with a small white exclamation point. Red arrows indicate negative interactions and blue arrows indicate positive interactions. The purple arrows indicate threats that may have both positive and negative interactions. For example, low to moderate severity fire may cause an increase in debris that is found within the forest, but high severity fires may also damage existing woody debris that salamanders may be sheltering under or otherwise depending upon for habitat. Climate change is identified as a threat which would increase the magnitude of other threats. The degree of the negative impacts from a stressor/threat can differ depending on the timing, scale, and intensity. It is important to note that many of these threats, when acting singly, may not have a large impact on the 3SS resiliency, but when acting in concert with other variables, may have a major impact. These interdependent impacts have not been teased out fully, and more research is needed to better understand how the 3SS geographic groups respond to these interacting threats.

3.13 Regulatory Mechanisms and Management Actions

California Endangered Species Act (CESA)

On June 27, 1971, the California Fish and Game Commission determined the Kern Canyon slender salamander warranted listing as a threatened species under the California Endangered Species Act. California Fish and Game Code § 2067 states a "(t)hreatened species" means a native species or subspecies of bird, mammal, fish, amphibian, reptile, or plant that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by this chapter. Section 2080 of the Fish and Game Code prohibits "take" of any species that the Fish and Game Commission determines to be an endangered species or a threatened species.

Take is defined in Section 86 of the Fish and Game Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill."

California Environmental Quality Act (CEQA)

California Environmental Quality Act of 1970 (CEQA) does not regulate land use, but requires all local and State agencies to avoid or minimize environmental damage, where feasible, during the course of proposed projects. CEQA provides protection for species that are state- or federally-listed as endangered, threatened, or rare. CEQA may be required for watershed restoration work and any restoration work that requires a Lake and Streambed Alteration Agreement, a.k.a. 1600 Agreement, (Section 1600 of Fish and Game Code), is also required to comply with CEQA.

California Species of Special Concern

The relictual slender salamander is a designated California Species of Special Concern. The Species of Special Concern designation carries no formal legal protection; the intent of the designation is to focus attention on animals of conservation risk, stimulate research on poorly known species, and achieve conservation and recovery of these animals before they meet criteria for listing as threatened or endangered. However, Species of Special Concern should be considered during the environmental review process. Section 15380 of the CEQA Guidelines clearly indicates that species of special concern should be included in an analysis of project impacts if they can be shown to meet the criteria of sensitivity outlined therein.

USFS Species of Conservation Concern

The relictual slender salamander, Kern Canyon slender salamander, and Kern Plateau salamander are designated as USFS Sensitive Species or Species of Special Concern under the authority of the 2012 planning rule for National Forest System land management planning (USFS 2019c, pp. 108–117). The USFS defines Species of Special Concern as plant and animal species for which there is concern about their ability to remain on a landscape for a long time. The USFS creates the Species of Special Concern list using the best available science in a proactive step intended to prevent species from becoming federally listed. Each National Forest has its own Species of Special Concern list, which is approved by the Regional Forester. The USFS land management plans are then designed to consider the needs of the Species of Special Concern and guide management that sustains habitat or conditions to support or restore secure Species of Special Concern populations to the extent practicable.

Chapter 4: Current Condition

4.1 Current Condition Summary of Methods

In this section, we describe the current condition of the 3SS by characterizing their status in terms of resiliency, redundancy, and representation (3Rs). We analyze the current conditions of the geographic groups of each species by considering the past and current threats that were defined in Chapter 3 and, when possible, evaluating the condition of the individual and population needs from Chapter 2. The analysis of the current condition of each geographic group allows us to assess geographic group resiliency. We then assess the redundancy and representation of each species under the current condition.

4.2 Current Condition Uncertainty

In order to determine the current condition of the 3SS we used the best available scientific information on the species. To aid our analysis of the 3SS in this SSA Report, we delineated geographic groups for each species by geographically grouping known sites of the 3SS. These geographic group designations allow us to assess the threats and conditions impacting multiple sites within specific areas of the range of a species. There are no population estimates for the 3SS. In the absence of population estimates, our analysis of the current condition of geographic groups is limited to the available records of observations for the species. Many of the recorded observations are from sites that were only surveyed once, 30–40 years ago, and we have no more recent information on the presence or absence of individuals from these sites. In these cases, there is uncertainty in assessing the current condition of the salamanders at these sites. The lack of information on population structure of the 3SS and the absence of robust records of observations contributes to uncertainty in the analysis of the current condition of the species.

Additionally, little information is available to assess the condition of the individual and population needs for each geographic group of the 3SS. Specifically, for some geographic groups we lack information on the availability of suitable microhabitat; aquatic and riparian habitats provided by seeps, springs, and streams; prey; and mates. There is sufficient evidence, as described in Chapter 2 of the SSA Report, that the 3SS need these resources, but there is insufficient information to determine the amount or quality needed to distinguish between low, moderate, and high-quality conditions for each geographic group or species.

4.3 Relictual Slender Salamander Current Condition

To assess the current condition of the relictual slender salamander, the 13 known sites of the species were categorized into three geographic groups: the Lower Kern River Canyon Geographic Group, the Lucas Creek Geographic Group, and the Squirrel Meadow Geographic Group. The relictual slender salamander is presumed to be extirpated from all sites within the Lower Kern River Canyon Geographic Group. While the Lower Kern River Canyon Geographic Group is presumably extirpated, this geographic group is important in the analysis of the redundancy and representation of the species under current condition. The two extant geographic groups are associated with patchy mesic habitat in conifer forest and oak woodland on Breckenridge Mountain (R. Hansen *in litt.* 2021, p. 1). In 2019, a search of mesic habitat on Breckenridge Mountain led to the discovery of four sites occupied by the relictual slender salamander. At two of those sites more than 20 individuals were found (E. Jockusch *in litt.* 2021a, p. 1). The habitat currently occupied by the species is estimated to consist of less than 0.4 ha (1 ac) (R. Hansen *in litt.* 2021, p. 1). The current condition of the relictual slender salamander has been impacted by road construction, grazing, timber harvest, hazard tree removal, fire, and climate change.

Lucas Creek Geographic Group

The Lucas Creek Geographic Group is composed of three sites near Lucas Creek on Breckenridge Mountain. At one site relictual slender salamanders are found along a segment of Lucas Creek near the headwater seepage of the creek. In this area, small numbers of relictual slender salamanders have been found under cover objects that are on the side of the stream (CNDDB 2022, unpaginated). At a site along an unnamed tributary to Lucas Creek to the east of the headwaters of Lucas Creek, a pair of relictual slender salamanders were found. The third site within this geographic group is to the south of the other sites and is located nearby a meadow and an unnamed tributary to Lucas Creek that is spring-fed. At this site one relictual slender salamander was found in a water valve box (CNDDB 2022, unpaginated). Within this geographic group relictual slender salamanders have only been observed in pairs or small numbers. It is unknown whether dispersal occurs among sites within this geographic group. The occupied sites are separated by 350 m (1,148 ft) or more, which is beyond the maximum distance traveled by slender salamanders (18.3 m (60.0 ft); see section 2.5 for information on dispersal) (Cunningham 1960, p. 96). However, Lucas Creek and associated riparian and meadow habitats may facilitate dispersal of relictual slender salamanders to occupied sites that are found along the creek and its tributaries. Dispersal between the Lucas Creek Geographic Group and the Squirrel Meadow Geographic Group is not thought to occur regularly as the geographic groups are separated by 5 km (3.1 mi).

The threats that are likely currently impacting this geographic group are road construction and maintenance, recreation, timber harvest, hazard tree removal, grazing, fire, and climate change. A county road runs between the sites in this geographic group and there are several USFS roads and trails throughout the area (Figure 10). All sites are within the Breckenridge grazing allotment (Figure 11). Grazing is allowed from April 1 to October 15, when salamanders on Breckenridge Mountain have been found active on the surface (Stewart 2010, p. 10). USFS timber harvest has taken place near all sites within this geographic group in 1987, 1988, 1996, and 2013, and habitat at these sites may still be impacted by legacy effects of these timber harvests (Figure 12). Additionally, extensive tree mortality necessitating hazard tree removal has occurred near Lucas Creek and its tributaries (Figure 13). This geographic group has not been impacted by fire since 1984 (Figure 14). However, the fire threat as measured by CAL FIRE is high to very high at the sites within this geographic group (Figure 15).

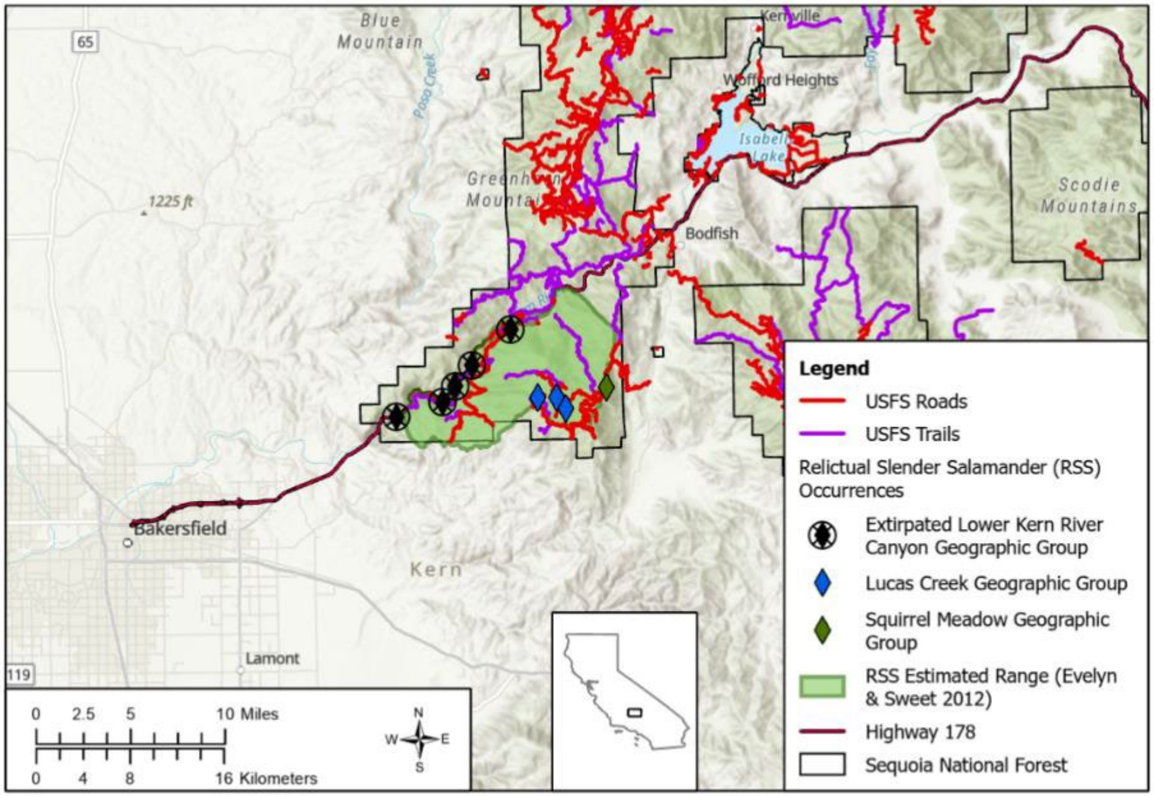


Figure 10: USFS roads and trails within the estimated historical range of the relictual slender salamander.

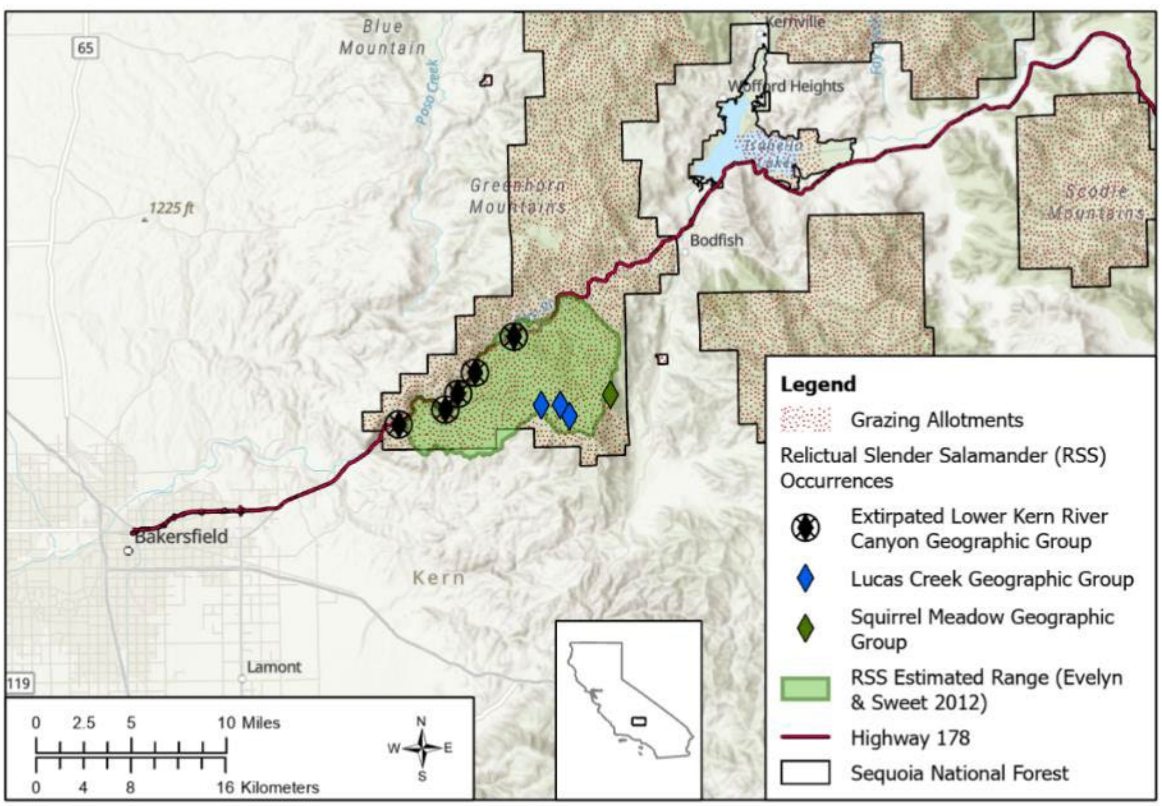


Figure 11: Grazing allotments within the estimated historical range of the relictual slender salamander.

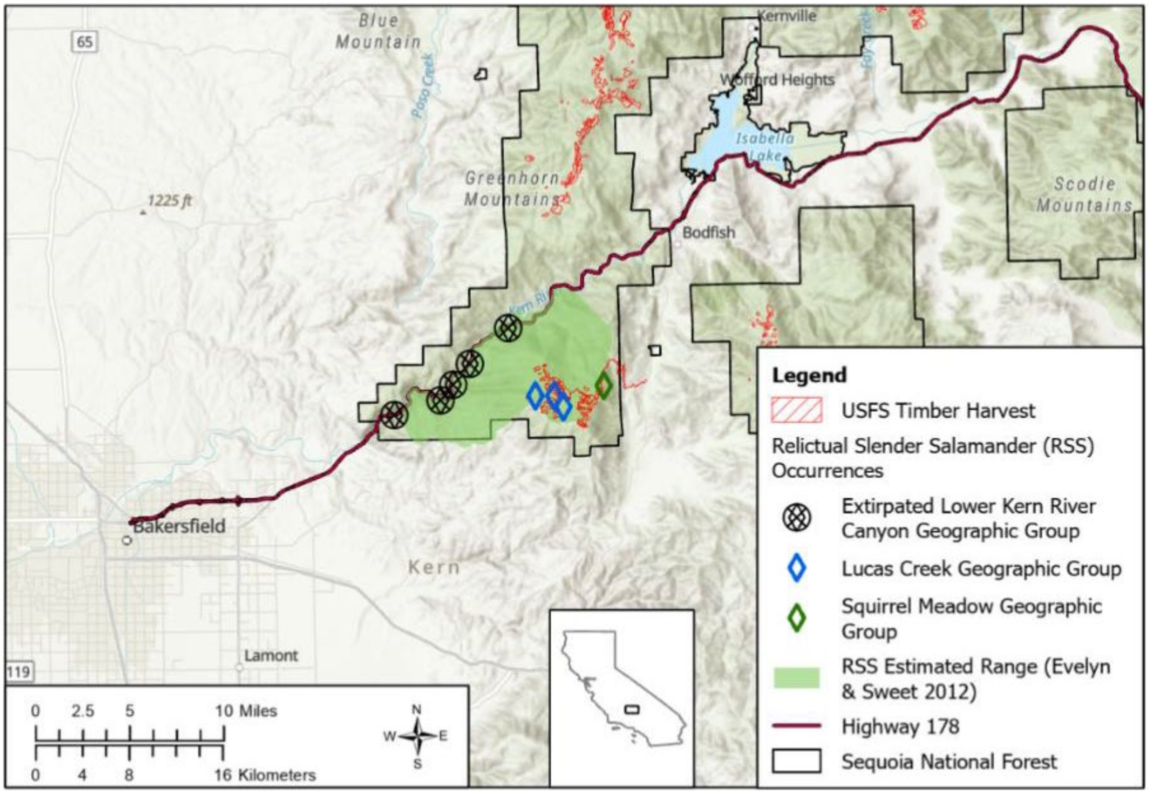


Figure 12: USFS timber harvest within the estimated historical range of the relictual slender salamander.

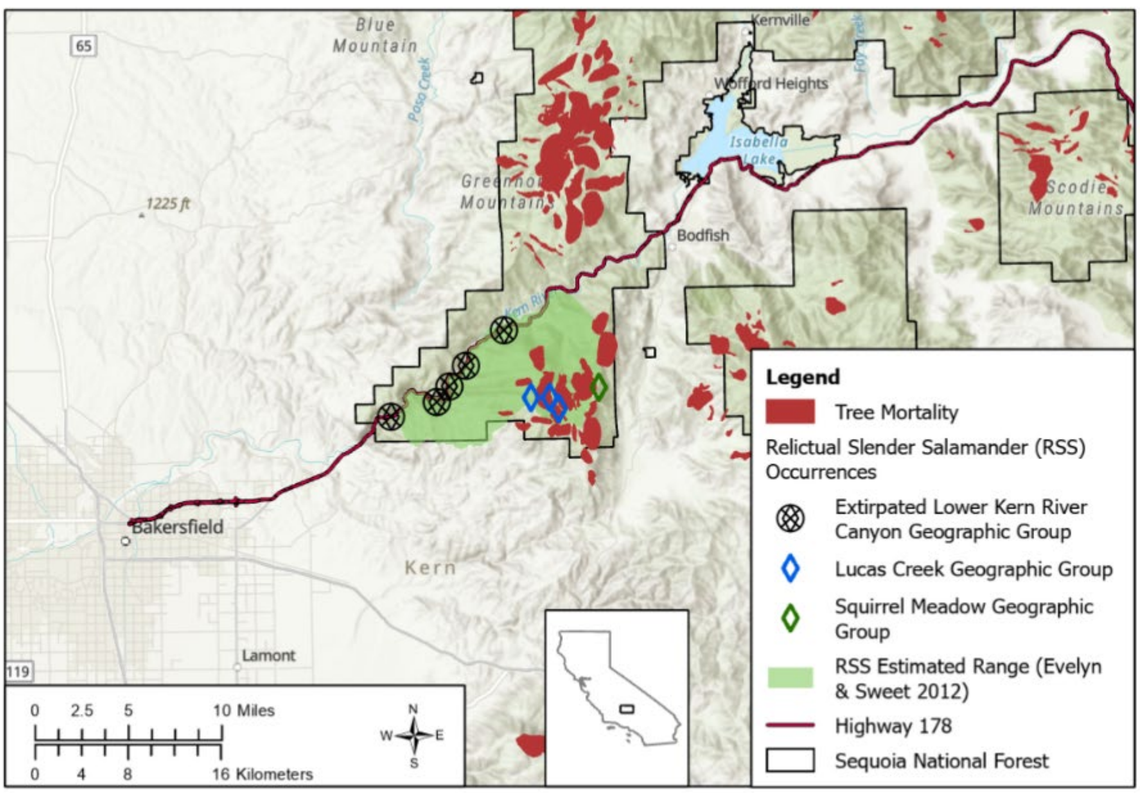


Figure 13: Tree mortality detected by aerial surveys over forested lands within the estimated historical range of the relictual slender salamander.

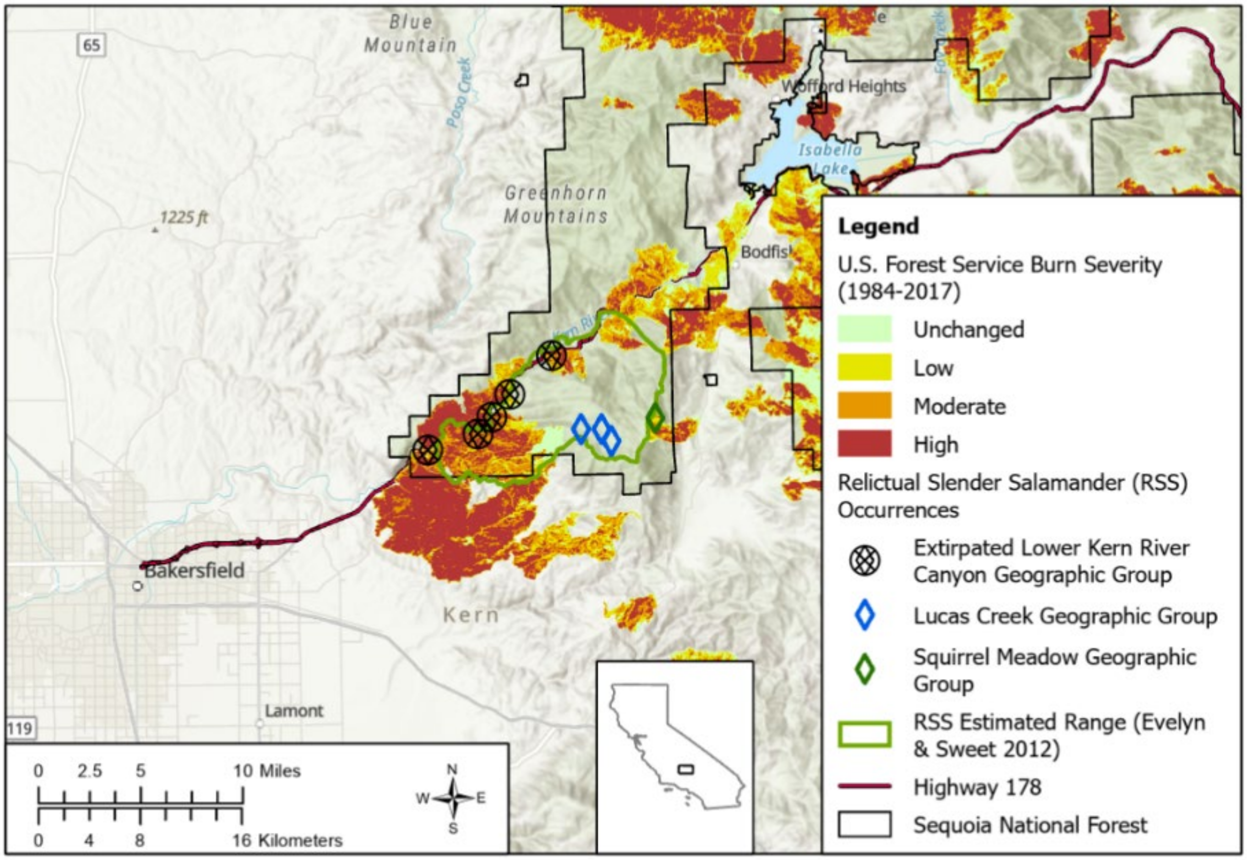


Figure 14: Wildfire location and severity from 1984–2017 within the estimated historical range of the relictual slender salamander. The wildfire severity data are from the USFS Pacific Southwest Region database for large fires since 1984 (https://www.fs.usda.gov/detail/r5/ landmanagement/gis/?cid =STELPRDB5327833). Unchanged burn severity is defined as areas of surface fire with no identified change in canopy cover or vegetation, low severity fire is defined as areas of surface fire with little change in cover and little mortality of the structurally dominant vegetation, moderate severity is defined as a mixture of effects on the structurally dominant vegetation, and high severity is defined as areas where the dominant vegetation has high to complete mortality.

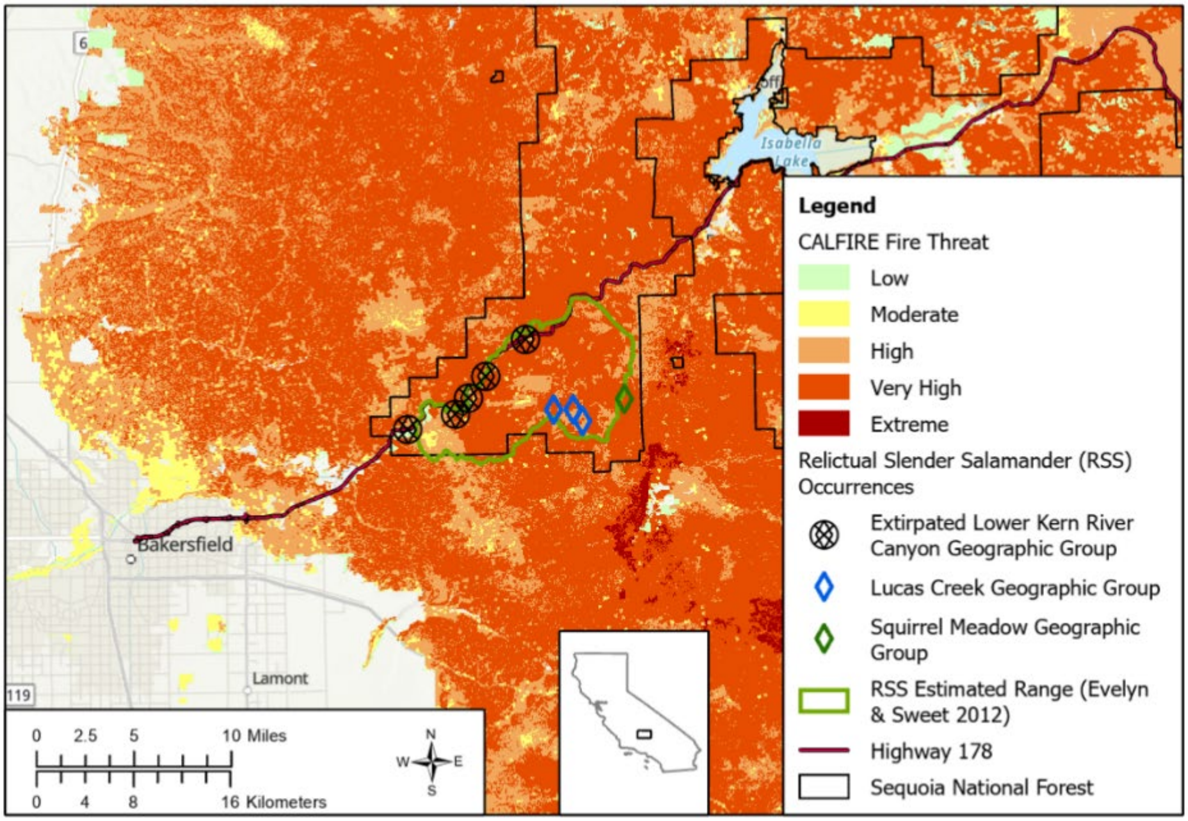


Figure 15: California Department of Forestry and Fire Protection's Fire and Resource Assessment Program wildfire threat within the estimated historical range of the relictual slender salamander. Wildfire threat indicates the potential of a particular area to burn.

Considering the ongoing threats to this geographic group and the impacts of these threats, the habitat characteristics of seeps, springs, and streams; cool and damp microhabitat; and cover objects may be degraded. Dispersal may be restricted by the distance between occupied sites and the presence of roads, trails, and timber harvest. Additionally, mates may be difficult to find due to possible barriers to dispersal and the small numbers of individuals observed at these sites. Regarding resiliency, this geographic group may be vulnerable to stochastic events because of its small size and the ongoing threats to habitat.

Squirrel Meadow Geographic Group

The Squirrel Meadow Geographic Group includes five sites occupied by the relictual slender salamander on Breckenridge Mountain to the east of Lucas Creek. We lack specific information on the exact location of the three sites associated with Mill Creek and the site within the Flying Dutchman drainage (See Table 1). We have more detailed information on the site that is northeast of Squirrel Meadow. At this site the relictual slender salamander is found within a strip of moist habitat about 1 m (3.3 ft) wide that is sustained by a seep (E. Jockusch *in litt.* 2021a, p. 1). The habitat at this site was damaged when a logging road was rerouted through the seep in the early 1980s (Jockusch *et al.* 2012, p. 18). Following these events, only four relictual slender salamanders were found at the site in 1983 and no individuals were found at the site during targeted searches over the following 20 years (Jennings and Hayes 1994, p. 24; Jockusch *et al.* 2012, p. 18; CNDDB 2022, unpaginated). A subsequent wildfire in 1988 that burned at low and moderate severity further compromised habitat at the site (Figure 14; Jockusch *et al.* 2012, p. 18). In recent years, the relictual slender salamander appears to have rebounded at the site, as 15 salamanders were found in 2017 and seven salamanders were observed in 2021 (CNDDB 2022, unpaginated; E. Jockusch *in litt.* 2021a, pp. 1–2; E. Jockusch *in litt.* 2021b, p. 3). Additionally, nine of the salamanders found in 2017 were gravid females that were found associated with a communal nest with more than 200 eggs (E. Jockusch *in litt.* 2021a, p. 2).

Road construction, timber harvest, hazard tree removal, fire, climate change, and possibly grazing have impacted the relictual slender salamander in this geographic group. As mentioned above, a USFS road runs directly through the seep that provides important habitat for this geographic group and other roads are located adjacent to the site (Figure 10). The site northeast of Squirrel Meadow is outside of the boundaries of USFS grazing allotments (Figure 11). However, other sites are within the Breckenridge grazing allotment (E. Jockusch *in litt.* 2021b, p. 3). Additionally, timber harvest in 2013 (Figure 12) and extensive tree mortality (Figure 13) have occurred along the roads near the site northeast of Squirrel Meadow. The fire threat is very high for this geographic group (Figure 15). Dispersal among sites in this geographic group is unknown but may be limited between sites that are within different drainages and separated by roads. Given the recent observations of groups of ovipositing individuals, access to mates may not be limited within this geographic group. Considering the past threats that considerably altered habitat and the ongoing threats of road maintenance, grazing, fire, and climate change, the habitat characteristics of seeps, springs, and streams; cool and damp microhabitat; and cover objects are likely degraded. Overall, the resiliency of this geographic group is reduced from historical conditions due to habitat degradation and the ongoing threats to the habitat.

Relictual Slender Salamander 3Rs Summary

Of the three known geographic groups of the relictual slender salamander, two are extant and one is presumed to be extirpated. The two extant geographic groups, Lucas Creek and Squirrel Meadow, are both on Breckenridge Mountain and are approximately 5 km (3.1 mi) apart. The extant geographic groups are composed of only a few occupied sites that have been impacted by stressors and continue to be influenced by some stressors. Therefore, the geographic groups likely have reduced resiliency from historical conditions. In terms of redundancy, the ability of the species to withstand catastrophic events, we note that the species has reduced redundancy from historical conditions as the species occupies fewer sites that are distributed over a smaller area, due to the extirpation of the Lower Kern River Canyon Geographic Group. In relation to the scale of catastrophic events that are likely to occur, such as the size of recent fires in the Sierra Nevada region, the redundancy of the species is very limited, and one fire could result in extinction of the species. The extirpated Lower Kern River Canyon Geographic Group included characteristics that were unique to the geographic group including habitat at lower elevation and salamanders that exhibited different periods of seasonal surface activity. The species may have lost genetic and ecological diversity through the extirpation of the Lower Kern River Geographic Group. Both extant geographic groups are found in similar habitat at high elevations on Breckenridge Mountain. Therefore, in terms of representation the species currently exists in a limited ecological setting that is reduced from historical conditions.

4.4 Kern Canyon Slender Salamander Current Condition

To assess the current condition of the Kern Canyon slender salamander, the 18 known sites of the species were categorized into two geographic groups, the Lower Kern River Canyon Geographic Group, and the Erskine Creek Canyon Geographic Group. There have been no observations of the Kern Canyon slender salamander at ten of these sites over the last 30–40 years (See Table 2 above and geographic group descriptions below for more details). Species experts indicate that the sites within the Lower Kern River Canyon have been searched for the species in recent years. However, the Kern Canyon slender salamander has not been found at these sites and negative survey results have not been reported to CNDDB (E. Jockusch *in litt.* 2021b, p. 2). Because there is a lack of reported negative survey results for the species, our analysis of the current condition of the species is limited and has significant uncertainty. Species experts also indicate that the abundance of the species has declined across the range of the species (Jockusch *in litt.* 2021b, p. 2). Furthermore, the species is currently found in wet patches of habitat in riparian habitat and the species no longer seems to occupy open grassland habitat (E. Jockusch *in litt.* 2021b, p. 2). The current condition of the Kern Canyon slender salamander has been impacted by roads, recreation, grazing, infrastructure development, fire, and climate change.

Lower Kern River Canyon Geographic Group

The Lower Kern River Canyon Geographic Group is composed of eleven sites in the small streams, seeps, and springs adjacent to the Kern River in the Lower Kern River Canyon from Stark Creek to south of Lake Isabella. Communication with species experts indicates that the Kern Canyon slender salamander may be largely or entirely extirpated from the nine westernmost sites within the Lower Kern River Canyon (E. Jockusch *in litt.* 2021b, p. 2). The most recent observations of the Kern Canyon slender salamander from sites in the Lower Kern River Canyon Geographic Group that were reported to the CNDDB are from 2007, 2008, and 2010 (CNDDB 2022, unpaginated; E. Jockusch *in litt.* 2021a, p. 3). However, species experts indicate that the Kern Canyon slender salamander has been observed frequently since 2010 on rock faces in the vicinity of the easternmost sites in the Lower Kern River Canyon (E. Jockusch *in litt.* 2021a, p. 3). Roads, recreation, grazing, infrastructure, fire, and climate change are currently impacting this geographic group.

Development and roads are present throughout the Lower Kern River Canyon. Widening of State Route 178 from 1968–1974 involved leveling, grading, and filling in the surface, which altered stream habitat along the southern side of the Lower Kern River Canyon where the Kern Canyon slender salamander was found (Lannoo 2005, p. 692; Evelyn and Sweet 2012, p. 112). The area has high recreation use with many access roads, trails, and camping areas (Figure 16). Dispersed camping was forbidden at some camp sites along the Lower Kern River beginning in the 1980s, therefore impacts of recreation in this area have likely decreased. Grazing takes place throughout the Lower Kern River Canyon and sensitive canyon bottom habitat has been degraded by ground disturbance and trampling by livestock (Figure 17) (USFS 2011a, p. 44). Between 2003 and 2004, three springs within Dougherty Canyon were fenced to exclude livestock and protect the riparian vegetation associated within the area of three of the sites occupied by Kern Canyon slender salamander (USFS 2011a, p.76).

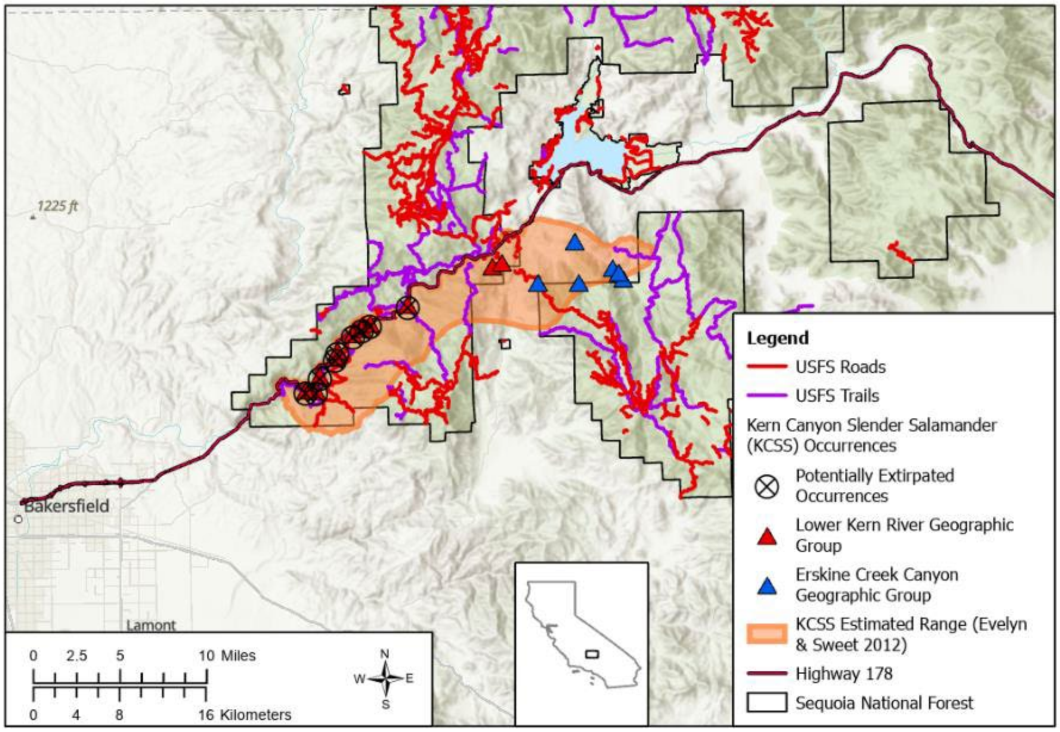


Figure 16: USFS roads and trails within the estimated range of the Kern Canyon slender salamander.

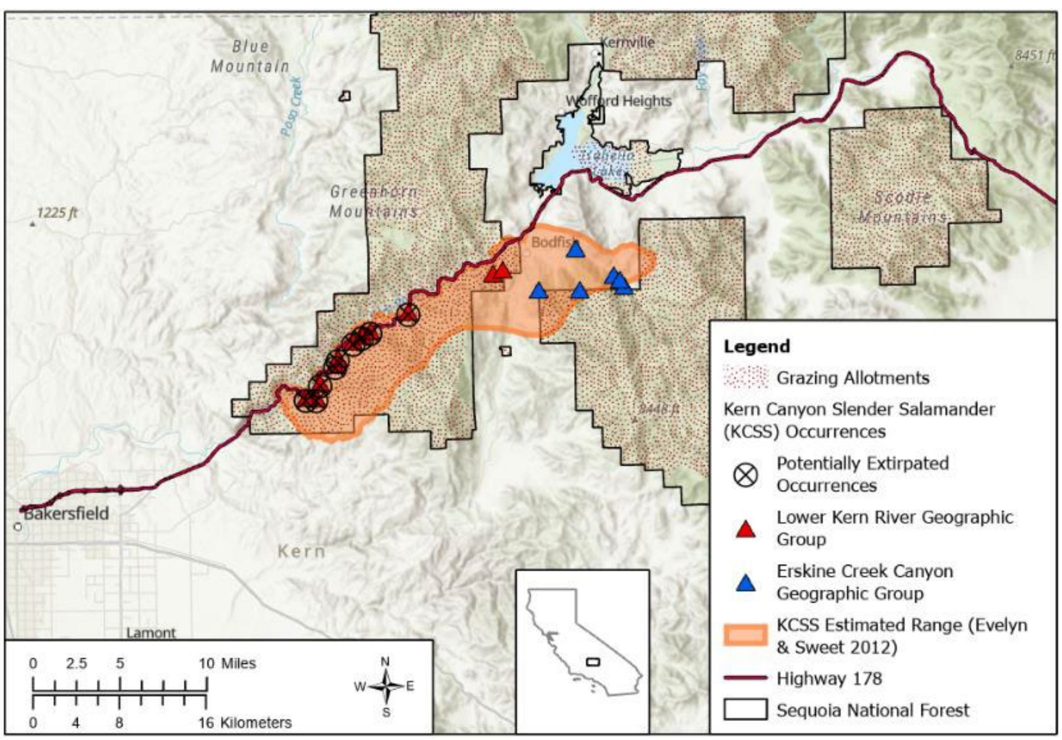


Figure 17: Grazing allotments within the estimated range of the Kern Canyon slender salamander.

Timber harvest has not occurred in the area (Figure 18), but some tree mortality associated with drought and insect outbreaks has occurred in proximity to occupied sites. This may result in hazard tree removal along State Route 178, USFS roads, or trails (Figure 19). Additionally, there is an electrical substation within 1,100 m (3,609 ft) of the eastern most site of this geographic group and a transmission line runs south from the substation passing within 900 m (2,953 ft) of the same site (Figure 20). The impact of maintenance of this utility infrastructure on Kern Canyon slender salamander habitat may be low due to the distance between the utility infrastructure and the patches of habitat occupied by the species. This geographic group has experienced frequent fires at a range of severities from 1988 to 2017 that may have impacted the condition of habitat (Figure 21). Moreover, fire suppression has affected riparian habitat by increasing conifer density and decreasing riparian herbaceous vegetation (USFS 2019c, p. 104). The fire threat remains high to very high throughout the canyon (Figure 22).

There is no information on dispersal or the availability of mates within the Lower Kern River Canyon. However, species experts believe the abundance of the Kern Canyon slender salamander has declined across its range (Jockusch *in litt.* 2021b, p. 2). Additionally, all sites are 300 m (984 ft) or more apart and there is a high density of roads and trails throughout the canyon. Therefore, dispersal and access to mates in this geographic group is likely limited given the poor dispersal ability of slender salamanders and the small numbers of individuals that have been observed in the Lower Kern River Canyon (See section 2.5 for information on dispersal). Considering the threats currently impacting this species, the habitat characteristics of seeps, springs, and streams; cool and damp microhabitat, and cover objects are likely degraded. Overall, the resiliency of the Lower Kern River Canyon Geographic Group is reduced from historical conditions due to the possible extirpation of the species from many sites within the geographic group and ongoing threats to habitat from road construction and maintenance, recreation, grazing, fire, infrastructure development, and climate change.

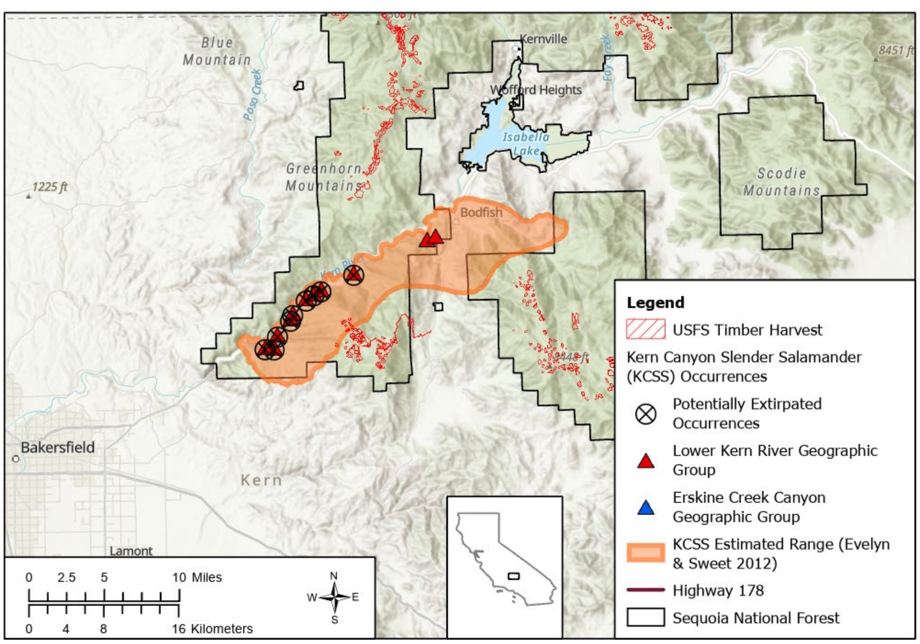


Figure 18: USFS timber harvest within the estimated range of the Kern Canyon slender salamander.

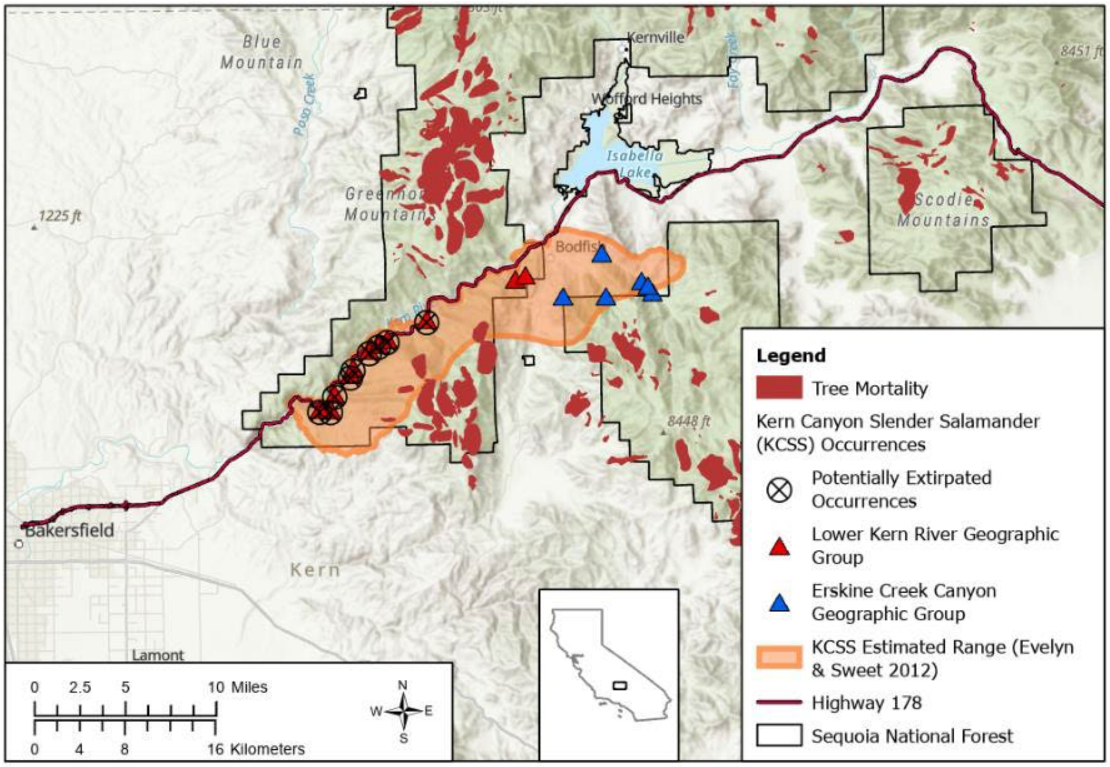


Figure 19: Tree mortality detected by aerial surveys over forested lands within the estimated ranged of the Kern Canyon slender salamander.

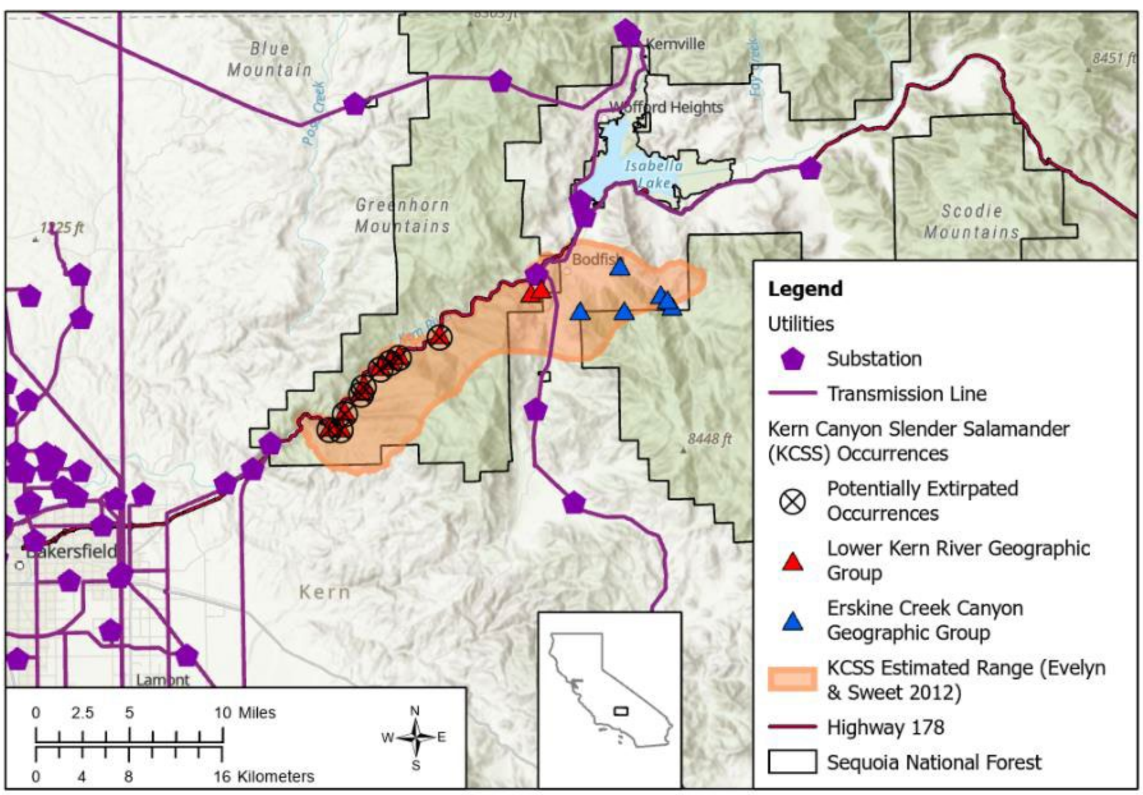


Figure 20: Utility substations and transmission lines within the estimated range of the Kern Canyon slender salamander.

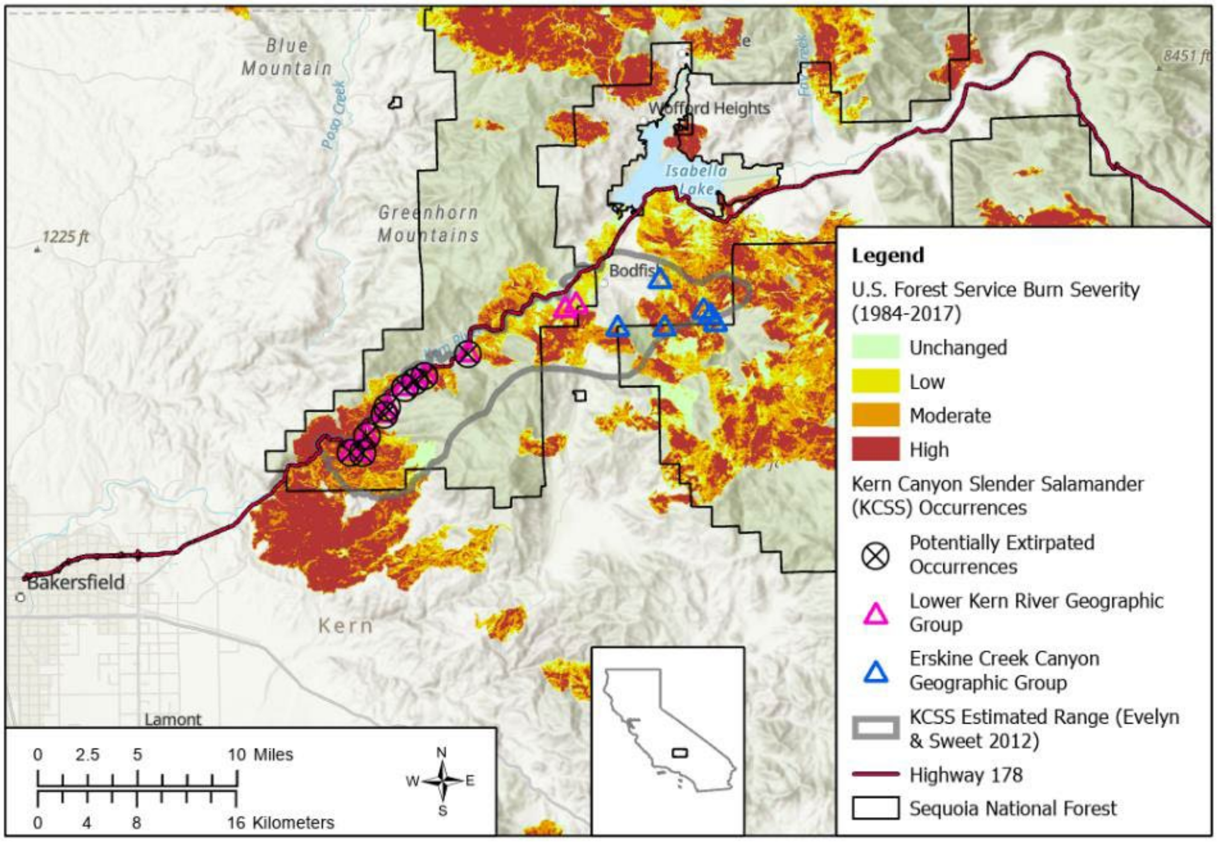


Figure 21: Wildfire location and severity from 1984–2017 within the estimated range of the Kern Canyon slender salamander. The wildfire severity data are from the USFS Pacific Southwest Region database for large fires since 1984 (https://www.fs.usda.gov/detail/r5/ landmanagement/gis/?cid =STELPRDB5327833). Unchanged burn severity is defined as areas of surface fire with no identified change in canopy cover or vegetation, low severity fire is defined as areas of surface fire with little change in canopy cover and little mortality of the structurally dominant vegetation, moderate severity is defined as a mixture of effects on the structurally dominant vegetation, and high severity is defined as areas where the dominant vegetation has high to complete mortality.

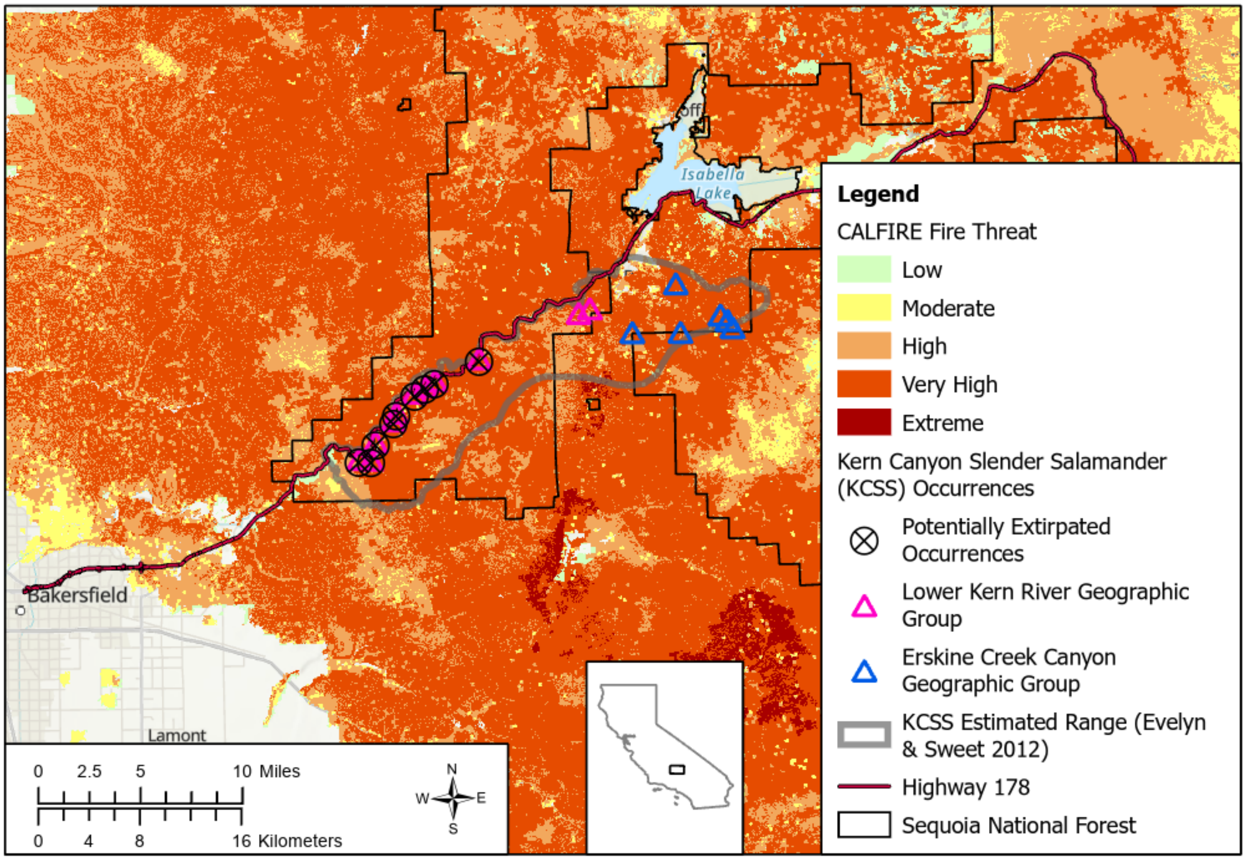


Figure 22: California Department of Forestry and Fire Protection's Fire and Resource Assessment Program wildfire threat within the estimated range of the Kern Canyon slender salamander. Wildfire threat indicates the potential of a particular area to burn.

Erskine Creek Canyon Geographic Group

The Erskine Creek Canyon Geographic Group is made up of four sites along Erskine Creek, two sites along Bodfish Creek, and one site near Eagle Peak in the Piute Mountains. Kern Canyon slender salamanders were most recently observed at sites within the Erskine Creek Canyon Geographic Group in 2001, 2010, and 2021 (CNDDB 2022, unpaginated). This geographic group is likely small due to the patchy habitat distribution and the small number of individuals that have been observed over limited surveys. There is no information on dispersal or availability of mates in this geographic group. Dispersal may be limited as the occupied sites within this geographic group are separated by 350 m (1,148 ft), which is greater than the maximum distance traveled by slender salamanders (See section 2.5 for more information on dispersal). However, the closest occupied sites are along Erskine Creek, and it is possible that the creek and associated riparian habitat may facilitate dispersal of the Kern Canyon slender salamander among sites along the creek.

This geographic group experiences many of the same threats that were described for the Lower Kern River Canyon geographic group. Although the sites of this geographic group are set back and separated from State Route 178, the electrical substation, and power lines (Figure 16). However, there are less trafficked dirt roads that run along both Erskine Creek and Bodfish

Creek. Fires of moderate and high severity in 1984 and 2010 likely degraded habitat in this geographic group (Figure 21) and the fire threat remains very high throughout the area (Figure 22). Additionally, this geographic group is outside of Sequoia National Forest, so the Kern Canyon slender salamander does not receive the same conservation protections that the species receives within Sequoia National Forest as designated USFS sensitive species. Overall, the current condition of this geographic group is likely better than the Lower Kern River Canyon Geographic Group as the concentration of threats is lower outside of the Lower Kern River Canyon. However, less is known about land management outside of the National Forest. The resiliency of this geographic group is likely reduced from historical conditions due to reduced abundance across the range of the species as well as past and ongoing habitat degradation from road construction and maintenance, fire, and climate change.

Kern Canyon Slender Salamander 3Rs Summary

Overall, there is uncertainty in the current condition of both geographic groups as there is paucity of recent information on this species. The resiliency of the two geographic groups is likely reduced from historical conditions due to the considerable existing threats to the species, especially within the Lower Kern River Canyon, and the decline in abundance of the species across its range (Jockusch *in litt.* 2021b, p. 2). Additionally, the species may be largely or entirely gone from many sites within the Lower Kern River Canyon. The redundancy of the species is likely reduced from historical conditions as the species currently occupies fewer sites that are distributed over a narrower range. In relation to the scale of catastrophic events that are likely to occur, such as the size of fires, the redundancy of the species is limited. In terms of representation, the species is no longer found in open grasslands. Therefore, the species may currently persist in a limited ecological setting that is reduced from historical conditions.

4.5 Kern Plateau Salamander Current Condition

In order to assess the current condition of the Kern Plateau salamander, the 35 known sites were categorized into three geographic groups: the Kern Plateau, the Inyo, and the Scodie Mountain geographic groups. There have been no surveys of Kern Plateau salamander at 12 of these sites over the last 30–40 years, but Kern Plateau salamander has been observed at eight sites within the last 20 years (see Table 3 above and geographic group descriptions below for more details). In the absence of more recent information and because suitable habitat continues to exist, we assume that the species continues to occupy these sites. Therefore, there is uncertainty in our analysis of the current condition of the species. The most recent observations of the species were in 2021 for the Kern Plateau Geographic Group, 2020 for the Inyo Geographic Group, and 2017 for the Scodie Mountain Geographic Group. The current condition of the species has been impacted by roads, recreation, grazing, timber harvest and hazard tree removal, fire, and climate change.

Kern Plateau Geographic Group

The Kern Plateau Geographic Group consists of 13 occupied sites within the Kern Plateau region of Sequoia National Forest. The Kern Plateau salamander is considered widespread on the Kern Plateau, especially within mesic areas (Lannoo 2005, pp. 690–691).

There are areas within this geographic group that have frequent motorized recreation use, tree harvest, hazard tree removal, grazing, and high potential for severe wildfires. High densities of USFS roads and trails are around all sites (Figure 23). Additionally, the majority of the sites are within grazing allotments (Figure 24), and many are within USFS timber harvest parcels (Figure 25) and areas with significant tree mortality (Figure 26). There have been recent low to moderate severity fires on the Kern Plateau that have overlapped with Kern Plateau salamander sites (Figures 26) and have likely had an impact on Kern Plateau salamander habitat. The fire threat is high to very high at most of the sites occupied by the Kern Plateau salamander on the Kern Plateau (Figure 27).

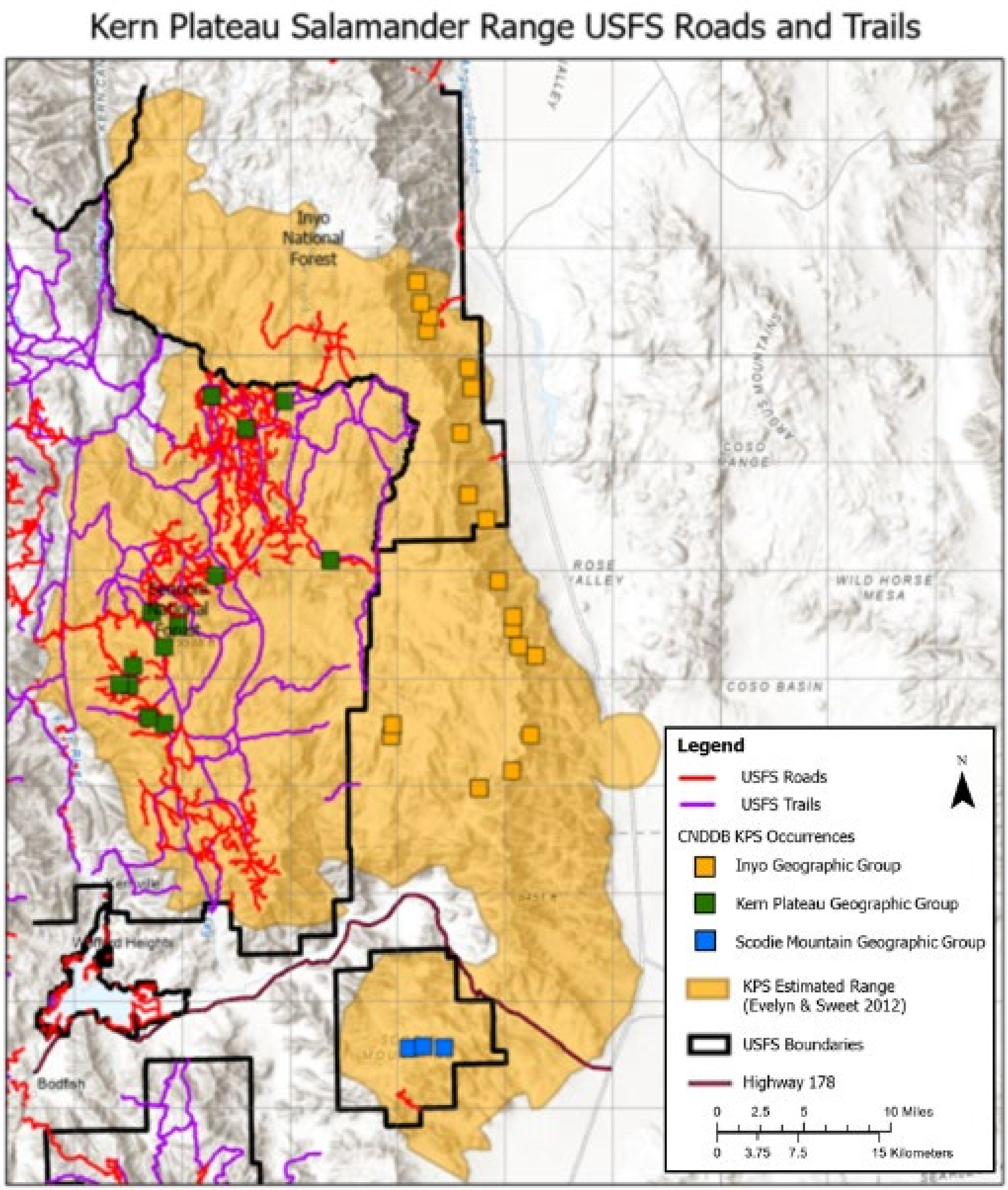


Figure 23: USFS roads and trails within the estimate range of the Kern Plateau salamander.

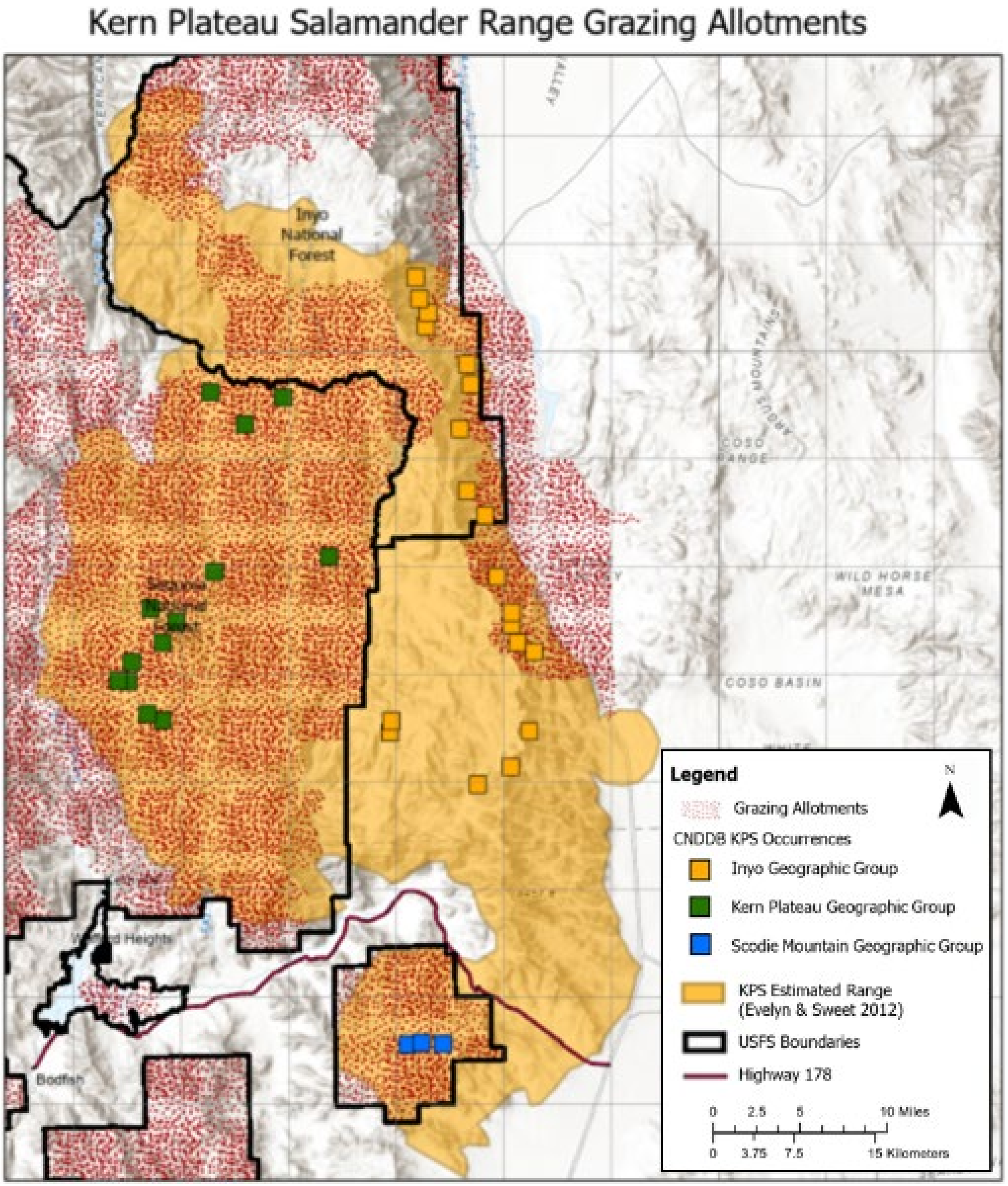


Figure 24: Grazing allotments within the estimated range of the Kern Plateau salamander.

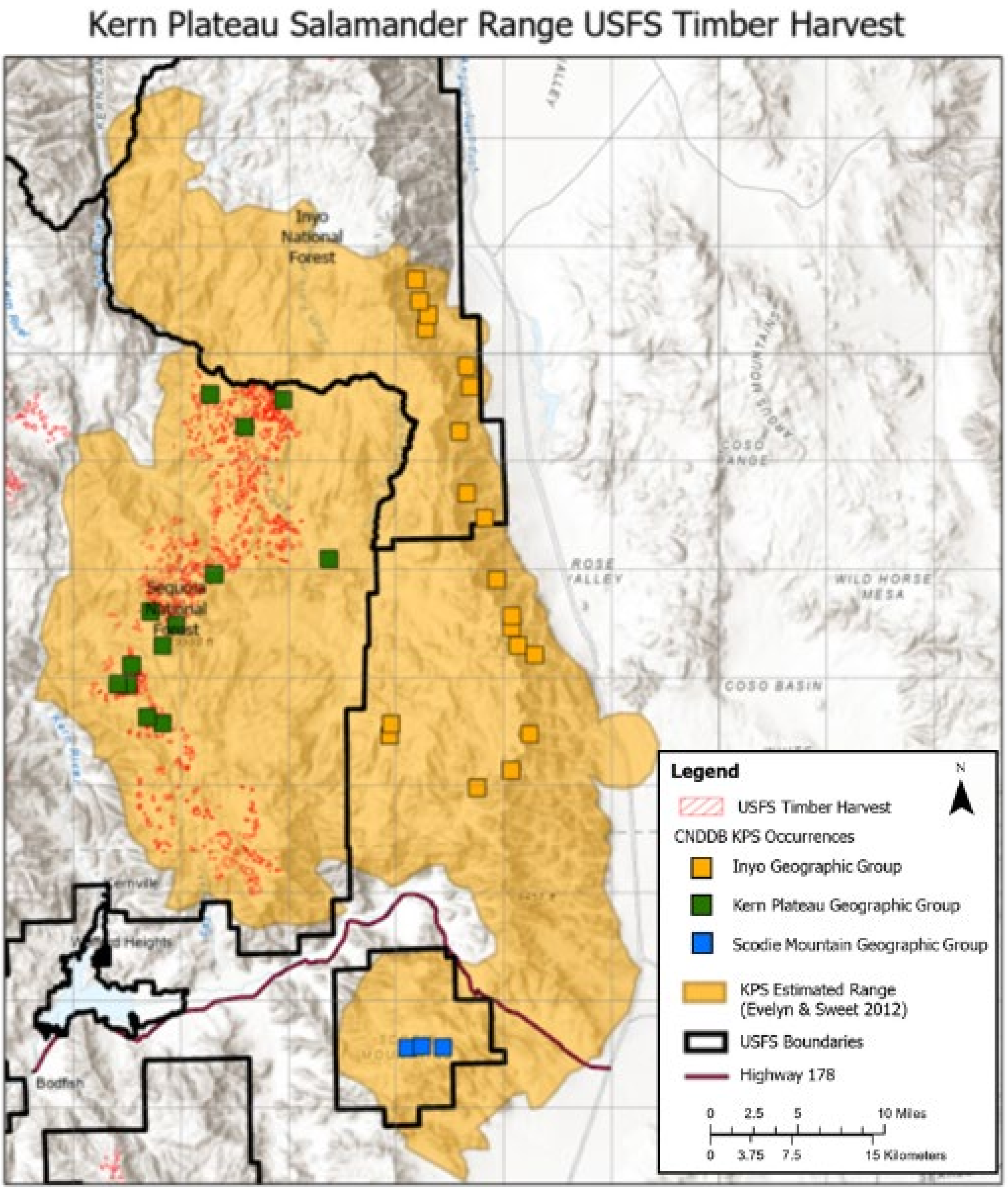


Figure 25: USFS timber harvest within the estimated range of the Kern Plateau salamander.

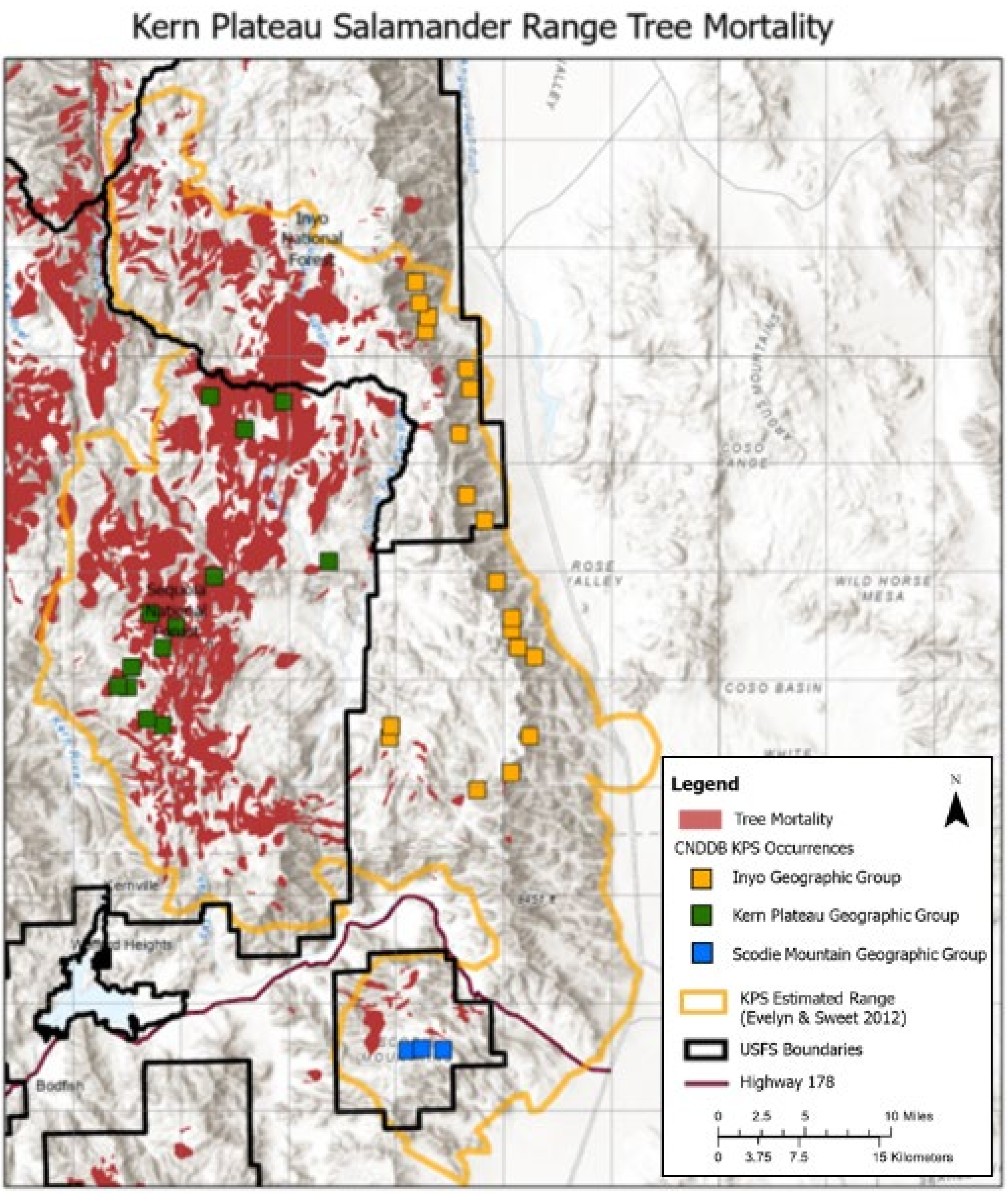


Figure 26: Tree mortality detected by aerial surveys over forested lands within the estimated range of the Kern Plateau salamander.

Kern Plateau Salamander Range Fire Location and Severity

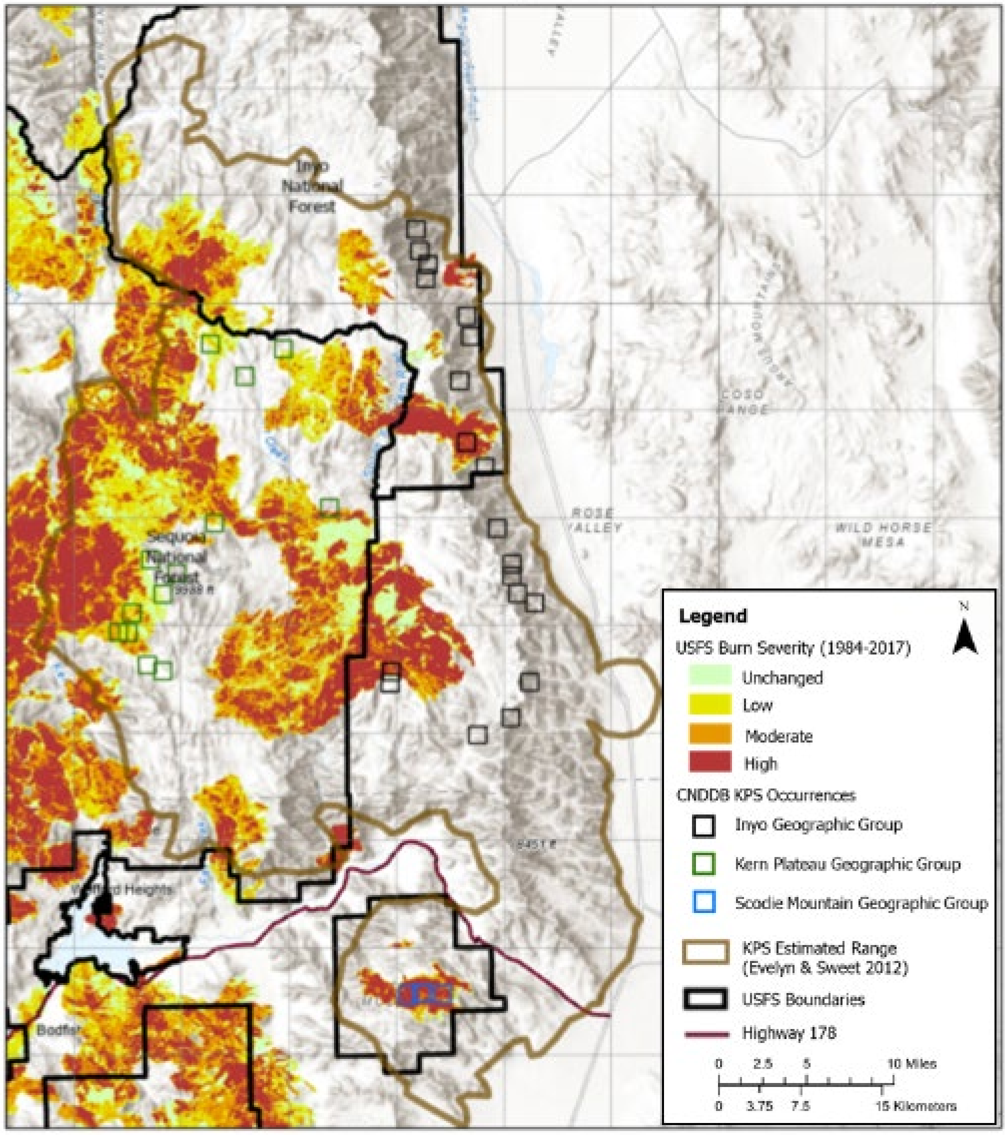


Figure 27: Wildfire location and severity from 1984–2017 within the estimated range of the Kern Plateau salamander. The wildfire severity data are from the USFS Pacific Southwest Region database for large fires since 1984 (https://www.fs.usda.gov/detail/r5/ landmanagement/gis/?cid =STELPRDB5327833). Unchanged burn severity is defined as areas of surface fire with no identified change in canopy cover or vegetation, low severity fire is defined as areas of surface fire with little change in cover and little mortality of the structurally dominant vegetation, moderate severity is defined as a mixture of effects on the structurally dominant vegetation, and high severity is defined as areas where the dominant vegetation has high to complete mortality.

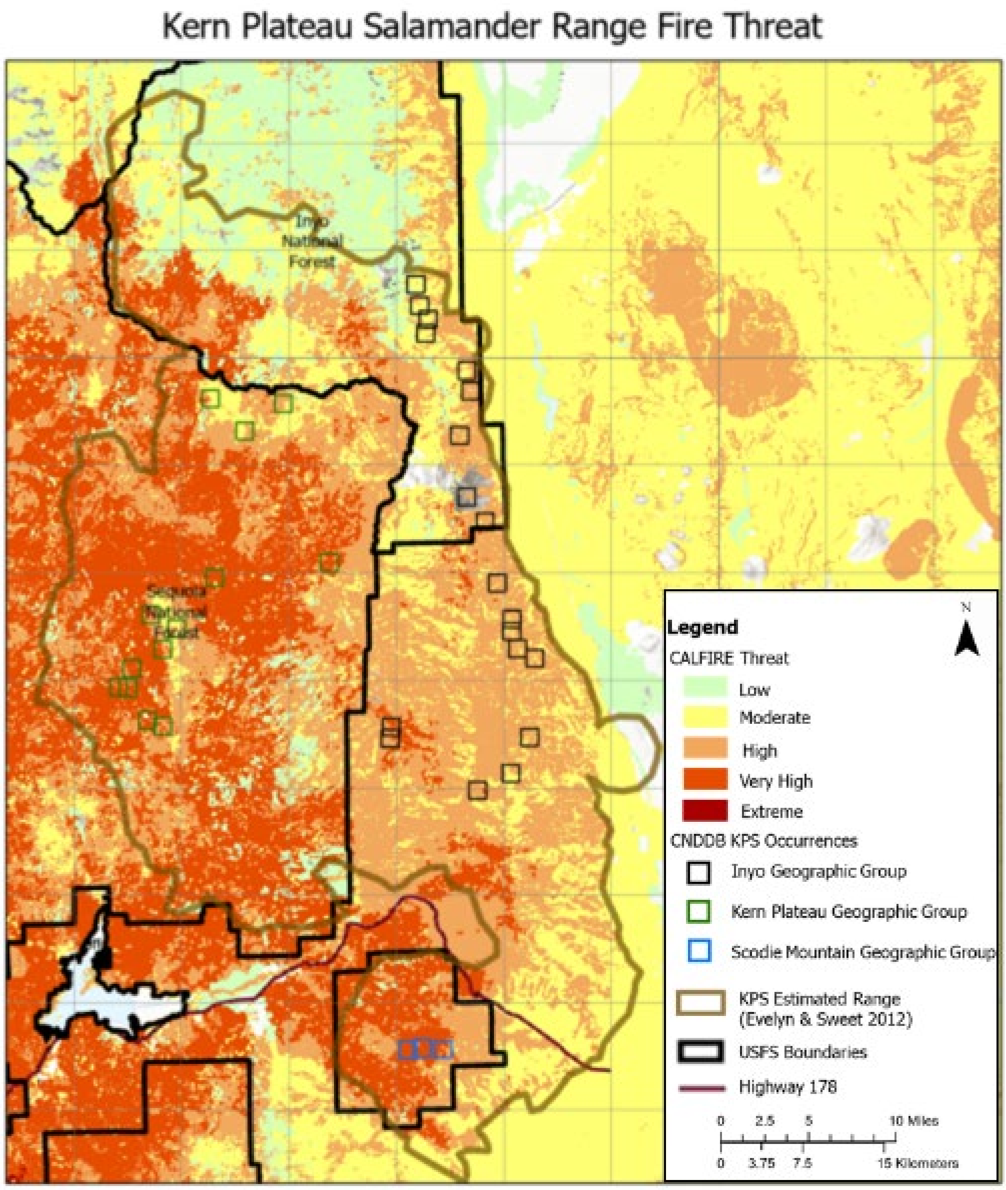


Figure 28: California Department of Forestry and Fire Protection's Fire and Resource Assessment Program wildfire threat within the estimated range of the Kern Plateau salamander. Wildfire threat shows the potential of a particular area to burn.

As sites in this geographic group are separated by 200 m (656 ft) or more, dispersal between sites may be limited (See section 2.5 for more information on dispersal). Additionally, there are many roads and trails between sites, which may further restrict dispersal of the species throughout the Kern Plateau. Given the known threats within the area, habitat features including cool and damp microhabitat; cover objects; and seeps, springs, and streams are likely somewhat degraded. The resiliency of this geographic group is likely reduced from historical conditions due to habitat degradation from roads, recreation, grazing, and fire.

Inyo Geographic Group

The Inyo Geographic Group is made up of 19 sites within the Owens and Indian Wells Valleys in Inyo County from Olancha Creek south to Ninemile Canyon. The Kern Plateau salamander is considered widespread within this area and is found in almost all stream-bearing canyons on the eastern flank of the Sierra Nevada (Lannoo 2005, pp. 690–691). Much of the habitat occupied by the Kern Plateau salamander in this geographic group is isolated within steep and rocky areas. As the dispersal ability of slender salamanders is limited (as discussed in section 2.5) and the distance between sites in the geographic group is greater than 700 m (2,297 ft), access to mates and dispersal between sites may be limited (See section 2.5 for more information on dispersal). Grazing, fire, and climate change are currently impacting the current condition of this geographic group.

This geographic group occurs both within and outside of Inyo National Forest. On land outside of the National Forest, the species is not afforded the same protections as it is within Inyo National Forest as a Species of Conservation Concern. The land management of lands outside of the National Forest is unknown. Most, but not all, of the sites located in Inyo National Forest are within grazing allotments and grazing is allowed during the spring when Kern Plateau salamander are active on the surface (Figure 24). Timber harvest has not occurred within this geographic group (Figure 25). However, some tree mortality has occurred within the area of the three northernmost occupied sites, but hazard tree removal may not be carried out in isolated areas (Figure 26). Three of the occupied sites experienced high to very high severity fire in 2000 and 2008 that likely degraded habitat (Figure 27). The fire threat within the range of this geographic group is moderate to high (Figure 28). Overall, the current condition of this geographic group is likely better than the Kern Plateau Geographic Group as the habitat is more isolated from roads and recreation, and timber harvest does not take place in the area. Due to prevalence of occupied sites ranging across many of the canyons on the eastern slope of the Sierra Nevada, and habitat that is less impacted and therefore likely in good condition, the current resiliency of the Inyo Geographic Group is likely similar to historical conditions.

Scodie Mountain Geographic Group

The Scodie Mountain Geographic Group is made up of three sites in the Scodie Mountains within Sequoia National Forest. This geographic group seems to be limited to small patches of habitat and is more isolated from the other geographic groups of the Kern Plateau salamander (Lannoo 2005, pp. 160–161). The most recent observation of one salamander from a site on the Scodie Mountains took place in 2017. There have been no other observations of Kern Plateau salamander from the other two Scodie Mountains sites in the past 40 years despite limited searches in the vicinity of these sites in 2016 and 2017 (C. Evelyn *in litt.* 2021, p. 1). Because recent available information is limited, our analysis of the current condition of this geographic group has uncertainty.

Many of the threats that are currently impacting the other two Kern Plateau salamander geographic groups are also impacting this geographic group, including roads, recreation, grazing, and fire. There are roads and trails in proximity to the occupied sites, and the nearby McIver's Cabin is a popular destination for off-highway vehicle recreationists and hikers (Figure 23).

Additionally, all the sites are located within grazing allotments (Figure 24). Timber harvest has not occurred within the Scodie Mountains (Figure 25) and the occurrence of tree mortality is low (Figure 26). All three sites experienced high severity fire in 1997 (Figure 27) that degraded forest habitat and likely impacted the availability of suitable microhabitat. After the fire, the habitat at these sites changed from single-leaf pinyon forest to *Ceanothus* thicket (C. Evelyn *in litt.* 2021, p. 1). The fire threat remains very high on the Scodie Mountains (Figure 28). Given the threats currently impacting this geographic group and the impact of the fire in 1997, the condition of habitat features including cool and damp microhabitat; cover objects; and seeps, springs, and streams is likely degraded. Due to the likely small size of this geographic group, access to mates may be limited. Additionally, the distance between sites is greater than 900 m (2,953 ft) which may limit dispersal among the sites within the geographic group (See section 2.5 for more information on dispersal). Regarding resiliency, the ability of this geographic group to withstand stochastic events is reduced from historical conditions due to habitat degradation from recreation, grazing, fire, and climate change.

Kern Plateau Salamander 3Rs Summary

There is no available information to indicate that the range of the species has decreased from historical conditions. Overall, the resiliency of the Kern Plateau and the Scodie Mountain geographic groups is reduced from historical conditions. While the habitat of the Inyo Geographic Group is currently impacted by some threats, the resiliency of the geographic group is likely similar to historical conditions. The species continues to maintain redundancy similar to the historical condition. The species occupies multiple sites that are distributed across three distinct geographic areas which provides redundancy to persist through catastrophic events such as large wildfires that have the potential to eliminate a population or geographic group. In terms of representation, the species continues to persist in the historical ecological setting that encompasses a range of elevations and both drier and wetter habitats, indicating some potential to adapt to future changes in environmental conditions.

Chapter 5: Viability and Future Conditions

5.1 Future Conditions Summary of Methods and Uncertainty

We have considered what the 3SS need for long term viability (Chapter 2), evaluated the past, current, and future factors that are influencing those needs (Chapter 3), and determined the current condition of the 3SS (Chapter 4). We now will analyze the future conditions of the 3SS by considering how those past and current influencing factors discussed in Chapter 4 will continue to act on the 3SS into the future, and how those influencing factors may affect the viability of the 3SS in the future. The future timeframes we are considering are both 20 and 50 years, which we chose because they are within the range of available climate change models and allow for reasonable extrapolations of current trends. As discussed in Chapter 4, while our analysis of the future conditions of the 3SS is based off the best scientific information available, there remains substantial uncertainty in our understanding of these species and how they will respond to future conditions. The uncertainty in the current distribution and current condition of the 3SS contributes uncertainty to our assessment of the long-term future viability of the species.

We developed future scenarios to analyze what may occur and how those factors affect the resiliency, redundancy, and representation of the 3SS over the next 20 and 50 years. The future scenarios consider the interactive effects of future climate change, described by Representative Concentration Pathways (RCPs) scenarios contributed by the Working Group III to the Fifth Assessment Report and described in the most recent Synthesis Report of the Intergovernmental Panel on Climate Change (IPCC 2014, pp. 9, 22, 57). There are four RCPs that contain predictions through the year 2100 ranging from RCP 2.6, "low" greenhouse gas emissions, to RCP 8.5, "very high" greenhouse gas emissions (IPCC 2014, p. 8). In our future conditions analysis, we consider the "intermediate" emissions scenario of RCP 4.5 (Scenario 1) and the "very high" emissions scenario of RCP 8.5 (Scenario 2).

The first scenario that we use to evaluate future conditions uses the IPCC RCP 4.5 scenario, a medium stabilization scenario where carbon dioxide (CO2) emissions continue to increase until the mid-21st century, but then stabilize. Between the years 2050 and 2100, atmospheric CO2 concentrations are expected to reach between 580 and 720 parts per million (ppm) CO2 (IPCC 2014, p. 9, Figure SPM.5). Under RCP 4.5, conditions, include a continued trend towards increased warming as well as increased frequency and severity of extreme events, such as droughts and floods. The mean annual increase in temperature change in the Sierra Nevada is projected to be 2.8 ºC by 2100, relative to 1971–2000 (Hegewisch *et al.* 2018, unpaginated). The second scenario that we use to evaluate future conditions uses the IPCC RCP 8.5 scenario where atmospheric CO2 concentrations are above 1,000 ppm CO2 between the years 2050 and 2100 (IPCC 2014, p. 9, Figure SPM.5). Under RCP 8.5, future conditions include a significant trend towards increased frequency and severity of extreme events, such as droughts and floods. The mean annual increase in temperature change in the Sierra Nevada is projected to be 4.9 ºC by 2100, relative to 1971–2000 (Hegewisch *et al.* 2018, unpaginated). Because of the influence of temperature on evapotranspiration, climate change is expected to result in drier soils with less runoff. Additionally, under RCP 8.5 by 2100, "no region of the planet is projected to experience significantly higher levels of annual average surface soil moisture…even though much higher precipitation is projected in some regions" (USGCRP 2017, pp. 232–238).

This SSA Report evaluates two plausible future scenarios across the next 20 and 50 years. Scenario 1 assumes RCP 4.5 climate change predictions, representing intermediate emissions conditions and the resulting climate forcing. For Scenario 2, RCP 8.5 predictions are used, representing very high greenhouse emissions conditions and the resulting changes in climate. Under both future scenarios, the threats that interact synergistically with climate change are expected to grow in magnitude over time with increasing greenhouse gas emissions. The threat of fire is associated with the effects of climate change, such as increased drought, lower soil moisture, and decreased snowpack. Therefore, fire will continue to be a threat into the future with greater fire threat associated with increasing greenhouse emissions. We expect the pattern of increasing severity of fire and area burned in fires will continue to increase into the future under both future scenarios, with greater increases under Scenario 2. Additionally, timber harvest and hazard tree removal will continue to increase in magnitude in the future with increasing greenhouse gas emissions, as drought conditions will continue to weaken trees and make them more susceptible to herbivory and disease. We do not have information to indicate that the existing threats of roads, recreation, grazing, and infrastructure will change in magnitude in the future. Furthermore, we have limited information on predation of the 3SS, but there is no indication that predation will increase from current levels in the future. As most of the range of the 3SS is within National Forest lands where the 3SS are considered USFS Sensitive Species or Species of Conservation Concern, the USFS is expected to continue to minimize the impacts of the threats posed by land management activities into the future. Therefore, these existing threats are expected to persist at the same magnitude as under the current condition for both future scenarios.

The ranges of projected changes in climatic variables under the two future scenarios throughout the area occupied by the 3SS are shown in Table 5. This table shows the difference between the historical mean from the years 1971–2000 and future projections that are derived from the mean of 20 downscaled climate models (the effects of large-scale climate processes at the local scale have been extrapolated from high-resolution regional climate models) (Abatzoglou 2013, entire; Hegewisch *et al.* 2018, unpaginated).

Table 5: Climatic and hydrologic variables and fire threat under the future scenarios.

Change in climate variables and fire threat from the historical mean (1971–2000)	Scenario 1: 20 Years	Scenario 1: 50 Years	Scenario 2: 20 Years	Scenario 2: 50 Years
Increase in annual mean temperature	1.1–1.2°C (2.0–2.2°F)	2.1–2.2°C (3.8–4.0°F)	1.3–1.4°C (2.4–2.6°F)	2.8–3.1°C (5.1–5.5°F)
Percent decrease in snow water equivalent, April 1st	14%–40%	50%–81%	18%–50%	72%–99%
Percent decrease in summer total soil moisture	0.3%–8.2%	1.1%–22.4%	0.8%–10.9%	5.7%–27.1%
Increase in annual extreme fire danger days	2.1–4.3 days	4.0–6.2 days	2.2–4.7 days	4.6–9.8 days

We examine the 3Rs of the 3SS under both plausible scenarios. Resiliency of geographic groups of these species depends on the availability of seeps, springs, and streams; cool and damp microhabitat; small invertebrate prey; and mates, and how these habitat factors influence species survival, dispersal, fecundity, and abundance. As we have a limited understanding of the species' biology and the current condition of the species, our ability to predict the future condition of the species based on changes in availability of individual and population needs is somewhat limited. However, we can predict the magnitude of threats to the species under the future scenarios and their impact on the viability of geographic groups of the 3SS. We do expect geographic groups of these salamander species to experience different changes to their habitat under these scenarios. We discuss the expected future resiliency of each geographic group based on the events that would occur under each scenario below. We then analyze the overall resiliency, representation, and redundancy of the species under each future scenario.

5.2 Scenario 1

Under Scenario 1, with RCP 4.5 greenhouse gas emissions, moderate warming and drying will occur throughout the range of the 3SS. Within 20 years, declines in soil moisture and reductions in snow water equivalent will be moderate. However, reductions in soil moisture and snow water equivalent are expected to more than double within 50 years. We expect these changes in climate will result in reduced water flow and more arid conditions in 3SS habitat. Drying will be more extreme in the high elevation areas occupied by the 3SS (Dettinger *et al.* 2018, p. 5), including areas on the Kern Plateau, Breckenridge Mountain, and the eastern slope of the Sierra Nevada. In these areas, the April 1st snow water equivalent will be reduced by up to 46 percent in the next 20 years and by up to 81 percent in the next 50 years. Reduction in snowpack will result in reduced water retention and runoff in the spring and summer, with runoff occurring earlier in the spring. Summer soil moisture is also projected to decline over time for all geographic groups of the 3SS, with the most extreme drying occurring during summers on the Kern Plateau, as the greatest loss of snowpack will occur at high elevation on the Kern Plateau. Within 20 years, it is likely that water levels will be reduced in some seeps, springs, and perennial springs. Within 50 years, water levels will be further reduced, and some water sources may have truncated periods of water retention. Additionally, there may be less cool and moist microhabitat at high elevations. We expect that these changes in hydrology will reduce the availability of suitable habitat for the 3SS.

Additionally, under Scenario 1, both the threat of fire and the severity of fires will increase throughout the range of the 3SS. The 3SS and their habitat will also be impacted by more frequent extreme weather events including winter storms and flooding. Increased fire and flooding will likely degrade seep, spring, and stream margin habitat and may result in direct mortality of salamanders. Additionally, increased tree mortality will lead to an increase in timber harvest and hazard tree removal. The presence of roads, recreation, grazing, timber harvest, and infrastructure will continue to impact 3SS and their habitat over the next 50 years. However, the USFS will continue to minimize impacts to the species on National Forest lands.

The following sections summarize the conditions of each of the 3SS under future condition Scenario 1, as described above. We use the best available information to project the likely future conditions of the 3SS. Overall, these summaries consider a combination of the species needs, current condition, and projected future condition under Scenario 1.

5.1.1 Relictual Slender Salamander

The two extant geographic groups of the relictual slender salamander occur at high elevation on Breckenridge Mountain and will therefore experience considerable warming and drying under the future conditions of Scenario 1. As the relictual slender salamander has a closer association with water than other slender salamanders, reduced water levels are expected to impact the condition of the relictual slender salamander to a greater degree. Under Scenario 1, it is likely that the water level of the seeps and creeks on Breckenridge Mountain will be reduced within 20 years. Within 20 years, we expect that reduced water levels and drying of soil combined with the continued existing threats of roads, recreation, grazing, timber harvest, and hazard tree removal will result in decreased condition of seep and creek margin habitat and suitable microhabitat. We expect that reduced habitat suitability will result in reductions in survival and abundance of relictual slender salamander and thereby, decreased resiliency within 20 years.

Within 50 years, we expect that water levels will be further reduced and some of the water sources on Breckenridge Mountain may experience more frequent or longer dry periods. As both extant geographic groups are dependent on small patches of moist habitat provided by a few seeps and creeks, we expect that additional drying of these water sources will further limit suitable habitat thereby further reducing the resiliency of both geographic groups. Additionally, the threat of fire will continue to be very high on Breckenridge Mountain, with an increasing number of annual days of extreme fire danger. As all extant sites of the relictual slender salamander are within a small area on Breckenridge Mountain, a single fire could damage a large portion of occupied habitat and extirpate both geographic groups. It is likely that within 50 years fire along with timber harvest, hazard tree removal, roads, recreation, and grazing will further degrade habitat occupied by the species. Within 50 years, both geographic groups are expected to be at greater risk of extirpation by stochastic events due to reduced resiliency. We also expect that within 50 years the representation and redundancy of the relictual slender salamander will be reduced from the current condition.

5.1.2 Kern Canyon Slender Salamander

Under Scenario 1 within 20 years, we expect that the water level of the seeps, springs, and streams that provide habitat for the Kern Canyon slender salamander will decline resulting in reduced condition of habitat. Habitat will also continue to be impacted by roads, heavy recreation use, grazing, infrastructure, and more frequent fires. We anticipate that the resiliency of both geographic groups will likely be slightly reduced from the current condition due to this habitat degradation.

Within 50 years, it is likely that water levels throughout both geographic groups will be further reduced. In 50 years, we expect that reductions in the quantity and quality of suitable habitat will result in minor reductions in the survival and abundance of Kern Canyon slender salamander within both geographic groups. We expect that the resiliency of both geographic groups of Kern Canyon slender salamander will be slightly reduced from the current condition. Both geographic groups are expected to retain occupied sites and therefore the species will maintain its current level of redundancy. We anticipate the Kern Canyon slender salamander will also retain ecological representation that is similar to the current condition. However, the Kern Canyon slender salamander will continue to be vulnerable to catastrophic events such as fires that are expected to occur more frequently under Scenario 1.

5.1.3 Kern Plateau Salamander

We expect that under Scenario 1 the habitat occupied by the Kern Plateau salamander at high elevations will be considerably impacted by climate change. Within 20 years, the water level of some seeps, springs, and streams that provide habitat for the three geographic groups is expected to be reduced. The existing threats of recreation, roads, and grazing are expected to continue to degrade habitat along with the increased incident of fire, timber harvest, and hazard tree removal. We anticipated that decreased quality of habitat within 20 years will slightly reduce the resiliency of all the Kern Plateau salamander geographic groups.

In 50 years, it is likely that water levels will be further reduced, and the period of water retention may be truncated for some water sources. Additionally, within 50 years summer total soil moisture is projected to decline and is expected to limit the amount of suitable microhabitat for the Kern Plateau salamander within all geographic groups. Furthermore, fire will likely degrade habitat occupied by the Kern Plateau salamander within all geographic groups. Because the Scodie Mountain Geographic Group is dependent on habitat provided by only a few springs, loss of water level in these springs will likely reduce the availability of suitable habitat and thereby the resiliency of the geographic group. As the Inyo and Kern Plateau geographic groups are composed of numerous occupied sites that are dependent on habitat provided by multiple water sources, reductions in water levels at some sites in these geographic groups will not have as great of an impact on the overall resiliency of these geographic groups. Under Scenario 1, within 50 years we expect the resiliency of all three Kern Plateau salamander geographic groups will be reduced from the current condition. The Scodie Mountain Geographic Group will likely have the lowest resiliency and will be at greater risk of extirpation by stochastic events. We expect that within 50 years under this scenario, the Kern Plateau salamander will have redundancy and representation similar to under the current condition.

5.1.4 Summary of 3Rs within 50 years for Scenario 1

Relictual Slender Salamander

- We expect that the resiliency of the Lucas Creek and Squirrel Meadow geographic groups will be reduced from the current condition.
- We anticipate that the representation and redundancy of the relictual slender salamander will be decreased from the current condition.

Kern Canyon Slender Salamander

- We expect that the resiliency of the Lower Kern River Canyon and Erskine Creek Canyon geographic groups will be slightly reduced from the current condition.
- We anticipate that the representation and redundancy of the Kern Canyon slender salamander will be similar to the current condition.

Kern Plateau Salamander

- We expect that the resiliency of the Inyo, Kern Plateau and Scodie geographic groups will be reduced from the current condition. The resiliency of the Scodie Mountain

Geographic Group will be the furthest reduced and the Scodie Mountain geographic group will be more vulnerable to stochastic events.

- We anticipate that the representation and redundancy of the Kern Plateau salamander will be similar to the current condition.

5.2 Scenario 2

Under Scenario 2, higher greenhouse gas emissions past mid-century (RCP 8.5) will result in greater warming and drying, increased threat of fire, and greater frequency of extreme weather events than under Scenario 1. The impacts from roads, recreation, grazing, timber harvest, and infrastructure are expected to continue to pose a threat to the 3SS and their habitat at the same magnitude as under the current conditions. The USFS will continue to minimize impacts to the 3SS within the National Forests; however, the 3SS sites located on private lands are not afforded the same protections.

The projected increase in temperature and decrease in April 1st snow water equivalent and summer total soil moisture for the next 20 years are slightly elevated from projections for Scenario 1. Therefore, the 3SS will likely experience comparable changes in habitat, such as reduced water flow, under both scenarios within the next 20 years. However, extreme weather events, such as winter storms that cause flooding resulting from the increased snowmelt and erosion of habitat in steep canyons, will be more frequent under this scenario. Additionally, periods of extreme drought are predicted to increase, which may result in less availability of surface water throughout the range of the 3SS. Drought will also increase tree mortality, necessitating greater hazard tree removal and timber harvest. Therefore, in 20 years, habitat degradation is expected to be greater under this scenario.

Within 50 years, under scenario 2, extreme weather events will occur more frequently. Additionally, temperatures and fire threat will increase, and April 1st snow water equivalent and summer total soil moisture will decrease to a greater degree than under Scenario 1. These changes will likely result in reduction of seep, spring, and stream habitats and suitable microhabitats. Loss of habitat will occur more often at high elevations where drying will be most severe. The April 1st snow water equivalent is predicted to decrease by up to 99 percent and summer total soil moisture is predicted to decrease by up to 27 percent at high elevations. Furthermore, prolonged droughts may reduce the time that the salamanders can be active on the surface without the risk of desiccation. At higher elevations, temperature increases may result in extended periods of favorable conditions and salamanders may increase their surface activity. However, the dry conditions predicted under this scenario are expected to restrict the surface activity of salamanders at higher elevations despite increased temperatures. At lower elevations temperature increases may exceed the tolerances of the species resulting in restricted surface activity. At all elevations restricted surface activity would limit the ability of salamanders to find prey and mates resulting in lower survival and fecundity.

The following sections summarize the conditions of each species under future condition Scenario 2, as described above. We use the best available information to project the likely future conditions of the 3SS. Overall, these summaries consider a combination of the species needs, current condition, and projected future condition under Scenario 2.

5.2.1 Relictual Slender Salamander

Under Scenario 2 within 20 years, we expect that seep and creek margin habitat on Breckenridge Mountain will be degraded due to decreased snowpack and more frequent extended droughts, affecting both extant geographic groups of the relictual slender salamander. Additionally, higher volume precipitation events may result in erosion of habitat along Lucas Creek and its tributaries. Increased temperatures and decreased soil moisture content may reduce available suitable microhabitat and may limit the surface activity of the relictual slender salamander. Reduced quality and quantity of suitable habitat is expected to result in decreased survival and abundance. Additionally, increased incidence of fire, timber harvest, and hazard tree removal and the continuation of stress on habitat caused by existing roads, grazing, and recreation will likely result in habitat degradation. We expect that within 20 years under this scenario, both geographic groups will experience a reduction in survival and abundance, thereby reducing the overall resiliency of the relictual slender salamander.

Reduced snowpack and soil moisture on Breckenridge Mountain predicted under this scenario within 50 years will likely result in loss of seep and creek margin habitat and suitable microhabitat conditions. Fewer occupied sites and reduced condition of remaining habitat on Breckenridge Mountain will reduce the resiliency of the relictual slender salamander. Therefore, the species will be more vulnerable to extirpation by stochastic events than under the current condition. Extirpation of the relictual slender salamander from multiple sites within 50 years is expected to greatly reduce the redundancy and representation of the relictual slender salamander. Under this scenario, we anticipate the relictual slender salamander will be vulnerable to extinction from catastrophic events. Furthermore, the increased incidence of fire may result in extirpation of the relictual slender salamander, as all occupied sites are distributed within a small area on Breckenridge Mountain.

5.2.2 Kern Canyon Slender Salamander

Under Scenario 2 within 20 years, we expect that the water level of the seeps, springs, and streams that provide habitat for the Kern Canyon slender salamander will decline. Additionally, as most sites occupied by the Kern Canyon slender salamander are located within narrow canyons along the margins of creeks and streams, habitat within both geographic groups of the Kern Canyon slender salamander will likely be degraded by more frequent higher volume precipitation and flooding events. Within 20 years, we anticipate that both geographic groups will experience reduced resiliency from the current condition.

In 50 years, we anticipate water levels will be further reduced throughout the range of the species and extreme storms will continue to occur more frequently, resulting in habitat loss. We expect that this loss of habitat combined with habitat degradation from the continued impact of high recreation use, grazing, road, infrastructure, and increased incidence of fire, will likely result in reductions in survival and abundance of the Kern Canyon slender salamander within 50 years. As a result, the resiliency of both geographic groups will likely be reduced from the current condition. We expect that habitat loss will result in less occupied sites within 50 years. Therefore, within 50 years, we expect that the redundancy and representation of the species will be further reduced from the current condition, as the species will occupy fewer sites and exist in a further limited ecological setting. We anticipate Kern Canyon slender salamander will be more vulnerable to extirpation from catastrophic events under this scenario.

5.2.3 Kern Plateau Salamander

Under Scenario 2, we expect that habitat for the species will be severely impacted by changes in climate. Within 20 years, the water level of seeps, springs, and streams that provide habitat for the three geographic groups will be reduced. Additionally, increased incidence of extreme weather events such as flooding may cause salamander habitat that is within the stream margins in narrow canyons to erode. The existing threats of recreation, roads and grazing will also continue to impact habitat. We anticipated that reduced seep, spring, and stream margin habitat; increased incidence of high severity fire, increased timber harvest and hazard tree removal; and persistence of other threats will reduce the survival, fecundity, and abundance of salamanders and reduce resiliency from the current condition in all geographic groups of Kern Plateau salamander within 20 years.

In 50 years, extreme decreases in snowpack and extended periods of drought will reduce water availability and the persistence of water sources throughout all geographic groups. We expect that some water sources will disappear, and as a result, some occupied sites within all geographic groups may be lost. Furthermore, reductions in soil moisture and increased temperatures will likely reduce the availability of suitable microhabitat for Kern Plateau salamander throughout all three geographic groups. We anticipate that unsuitable conditions will severely limit the surface activity of salamanders, thereby further impacting the survival, fecundity, and abundance and reducing the resiliency of geographic groups. Within 50 years, the resiliency of all three geographic groups of Kern Plateau salamander will be reduced due to unfavorable conditions and habitat loss. We expect that the Scodie Mountain Geographic Group will be most vulnerable to stochastic events. Kern Plateau salamander is anticipated to have reduced redundancy and representation from the current condition and will be more vulnerable to catastrophic events under this scenario within 50 years.

5.2.4 Summary of 3Rs within 50 years for Scenario 2

Relictual Slender Salamander

- We expect that the resiliency of the Lucas Creek and Squirrel Meadow geographic groups will be greatly reduced from the current condition and will be more vulnerable to extirpation by stochastic events than under the current condition.
- We anticipate that the representation and redundancy of the relictual slender salamander will be further decreased from the current condition and the species will be at greater risk of extirpation by catastrophic events compared to the current condition.

Kern Canyon Slender Salamander

- We expect that the resiliency of the Lower Kern River Canyon and Erskine Creek Canyon geographic groups will be reduced from the current condition.
- We anticipate that the representation and redundancy of the Kern Canyon slender salamander will be further reduced from the current condition and the species will be more vulnerable to catastrophic events than under the current condition.

Kern Plateau Salamander

- We expect that the resiliency of the Inyo, Kern Plateau, and Scodie Mountain geographic groups will be reduced compared to the current condition. The Scodie Mountain Geographic Group will be the most vulnerable to stochastic events.
- We anticipate that the representation and redundancy of the Kern Plateau salamander will be reduced from the current condition and the species will be more vulnerable to catastrophic events than under the current condition.

Chapter 6: Status Assessment Summary

This SSA Report describes the influences to the viability of the 3SS as well as the current conditions of the 3SS and two plausible future scenarios. The goal of this SSA is to describe the viability of the 3SS, addressing the needs of individuals, geographic groups, and species in terms of resiliency, redundancy, and representation. Below we provide a summary of the overall current condition and future condition under Scenarios 1 and 2 for each species.

6.1 Overall Assessment of the Relictual Slender Salamander Viability

Under the current condition, the relictual slender salamander occupies only part of the species' historical range as the Lower Kern River Canyon Geographic Group is presumed to be extirpated. The extant geographic groups are composed of small patches of occupied habitat that are currently impacted by multiple existing threats. These geographic groups have been impacted by roads, recreation, grazing, timber harvest, hazard tree removal, fire, and climate change. Consequently, the resiliency of the extant geographic groups is likely reduced from historical conditions. In terms of redundancy, within the two extant geographic groups there are only eight sites occupied by the species and they are distributed within a small area on Breckenridge Mountain. In comparison to the scale of catastrophic events such as recent fires in the Sierra Nevada Region, the relictual slender salamander has limited redundancy under the current condition. Extirpation of the Lower Kern River Canyon Geographic Group reduced the environmental diversity encompassed by the species as representation at lower elevations was lost. Therefore, regarding representation, the species currently exists in a more limited ecological setting.

Under future Scenario 1, climate change is projected by RCP 4.5 and increasing threats include extreme weather events, fire, timber harvest, and hazard tree removal. Under the conditions for this scenario, the habitat quality of the relictual slender salamander is expected to decline. We anticipate poor habitat quality will result in reduced resiliency and the two extant geographic groups will be at greater risk of extirpation from stochastic events. We expect both redundancy and representation will be reduced from the current condition and the species will be more vulnerable to catastrophic events.

Under future Scenario 2, where climate change is projected by RCP 8.5 and increasing threats include more frequent drought and flooding, high-severity fire, timber harvest, and hazard tree removal, we expect that habitat loss will occur throughout both extant geographic groups. As a result, we anticipate greatly reduced resiliency and the relictual slender salamander will be increasingly vulnerable to extirpation from stochastic events. Additionally, the redundancy and representation of the species are expected to be considerably reduced from the current condition and the relictual slender salamander will be at greater risk of extirpation by catastrophic events.

6.2 Overall Assessment of the Kern Canyon Slender Salamander Viability

Based on the best available information, under the current condition, the Kern Canyon slender salamander may be largely or entirely extirpated from a portion of the species' range within the Lower Kern River Canyon. The resiliency of both geographic groups is likely reduced from historical conditions due to the impact of roads, recreation, grazing, infrastructure, fire, and climate change. In terms of redundancy, the species is thought to currently occupy approximately nine sites that are distributed over a small area within and outside of Sequoia National Forest. In relation to the scale of catastrophic events such as fires, the redundancy of the species is limited in the current condition. Regarding representation and the breadth of environmental diversity encompassed by the species, the Kern Canyon slender salamander may currently exist in a more limited ecological setting as the species may no longer occupy open grassland habitat and sites at lower elevation within the Lower Kern River Canyon.

Under future Scenario 1, climate change is projected by RCP 4.5 and increasing threats include extreme weather events and fire. Under these conditions, the habitat quality of both geographic groups of the Kern Canyon slender salamander is expected to decline. Reduced habitat quality is anticipated to result in slightly reduce resiliency from the current condition. We expect that the Kern Canyon slender salamander will maintain the current level of redundancy and representation under this scenario. However, the Kern Canyon slender salamander will continue to be vulnerable to catastrophic events such as fire that are expected occur frequently in the future.

Under future Scenario 2, where climate change is projected by RCP 8.5 and increasing threats include more frequent drought, flooding, and high-severity fire, further habitat degradation as well as habitat loss are expected. As a result, resiliency is anticipated to be reduced and the Kern Canyon slender salamander will be more susceptible to stochastic events. We expect that redundancy and representation will be reduced from the current condition as the species will occupy fewer sites and exist in a further restricted ecological setting. The Kern Canyon slender salamander will be vulnerable to extirpation from catastrophic events under this scenario.

6.3 Overall Assessment of the Kern Plateau Salamander Viability

Based on the best available information, the Kern Plateau salamander continues to occupy its historical range. Overall, the resiliency of the Kern Plateau and the Scodie Mountain geographic groups is likely reduced from historical conditions due to the impacts of roads, recreation, grazing, timber harvest, hazard tree removal, fire, and climate change. While the habitat of the Inyo Geographic Group is currently impacted by some existing threats, the resiliency of the geographic group is likely similar to historical conditions. In terms of redundancy and the ability of the species to withstand catastrophic events, the Kern Plateau salamander occupies multiple sites that are distributed across three geographic areas. Therefore, the Kern Plateau salamander continues to maintain redundancy similar to historical conditions. In relation to the scale of catastrophic events such as fire, the redundancy of the species is somewhat limited. In terms of representation, the Kern Plateau salamander continues to persist in the historical ecological setting that encompasses a range of elevations and habitat types.

Under future Scenario 1, climate change is projected by RCP 4.5 and increasing threats include extreme weather events, fire, timber harvest, and hazard tree removal. The quality of some habitat within all geographic groups of the Kern Plateau salamander is expected to decline. Poor habitat condition is anticipated to result in slightly reduced resiliency of the Kern Plateau and Inyo geographic groups and greatly reduced resiliency of the Scodie Mountain Geographic Group. We expect that under this scenario, the Kern Plateau salamander will maintain redundancy and representation similar to the current condition.

Under future Scenario 2, climate change is projected by RCP 8.5 and increasing threats include more frequent drought and flooding, high-severity fire, timber harvest, and hazard tree removal, habitat loss across all geographic groups of the Kern Plateau salamander is expected. We anticipate that loss of habitat, and possible loss of occupied sites, will reduce the resiliency of all three geographic groups. The Scodie Mountain Geographic Group is expected to be increasingly vulnerable to extirpation by stochastic events. Furthermore, we anticipate the representation and redundancy of the Kern Plateau salamander will be reduced from the current condition and the species will be more vulnerable to catastrophic events.

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8.0 Appendix

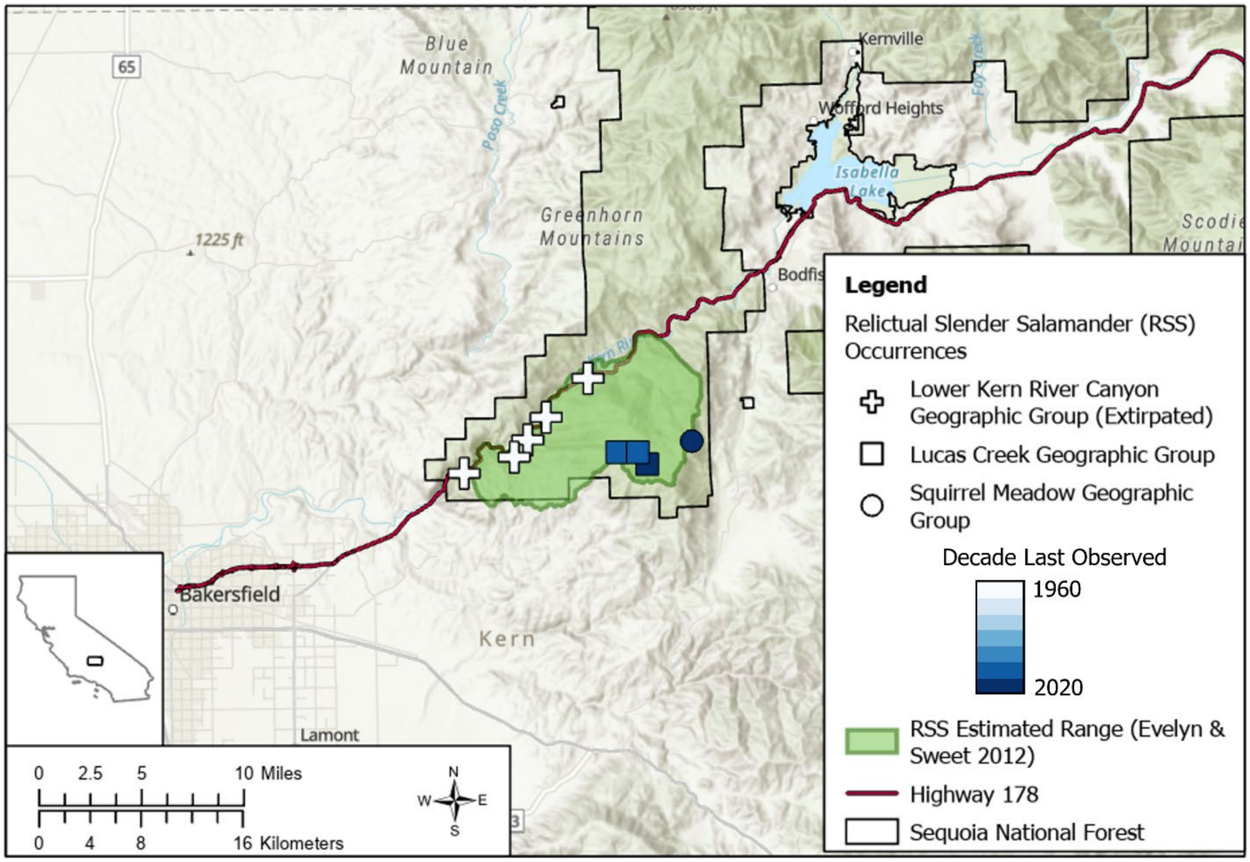

Figure A-1: The decade of the most recent observations of relictual slender salamanders at each site (CNDDB 2022, unpaginated). Four sites that were found in 2019 are not mapped here as the locations of the sites have not been reported to CNDDB (See Table 1).

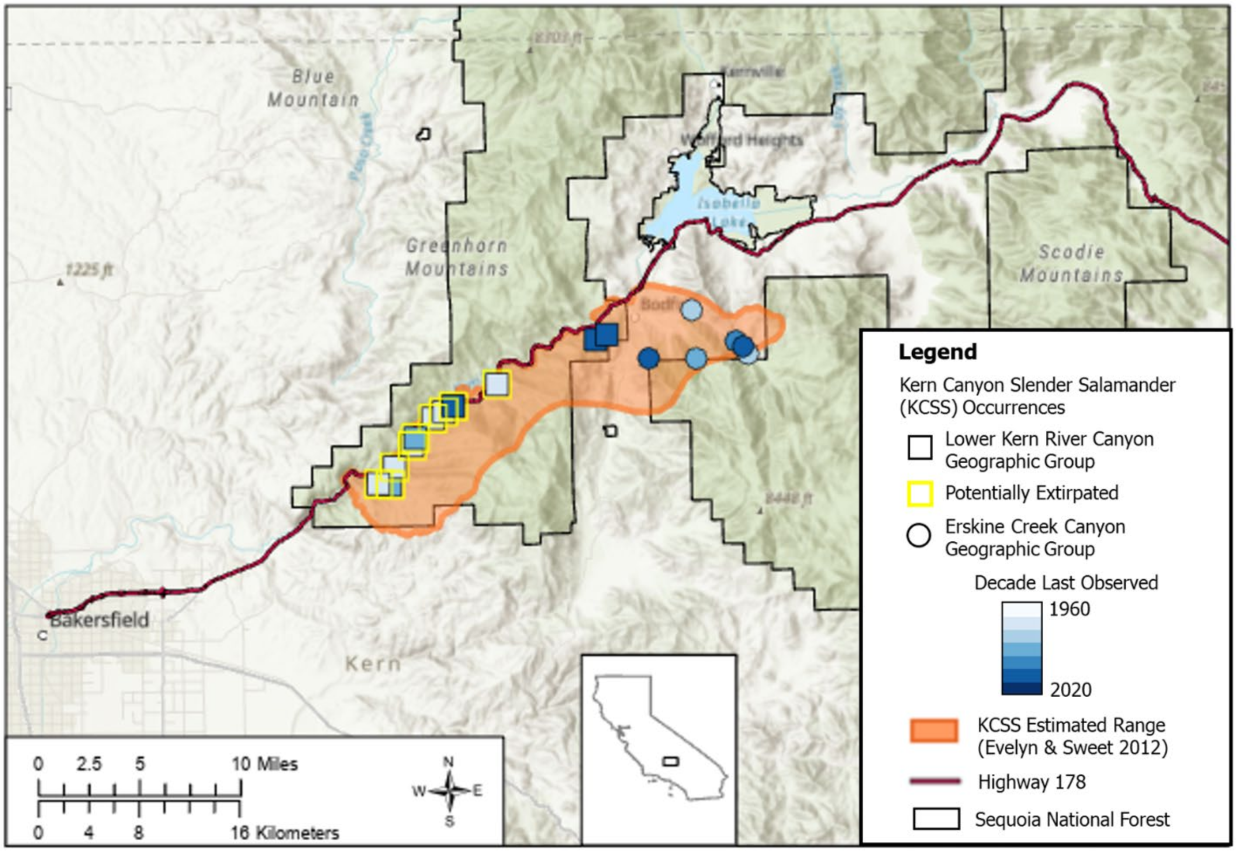

Figure A-2: The decade of the most recent observation of Kern Canyon slender salamanders at each site (CNDDB 2022, unpaginated). One site (Bodfish Creek B) is not mapped here because the specific location of the site has not been reported to CNDDB (See Table 2). The Eagle Peak site is mapped to a general description of the location of the site that has not been reported to CNDDB.

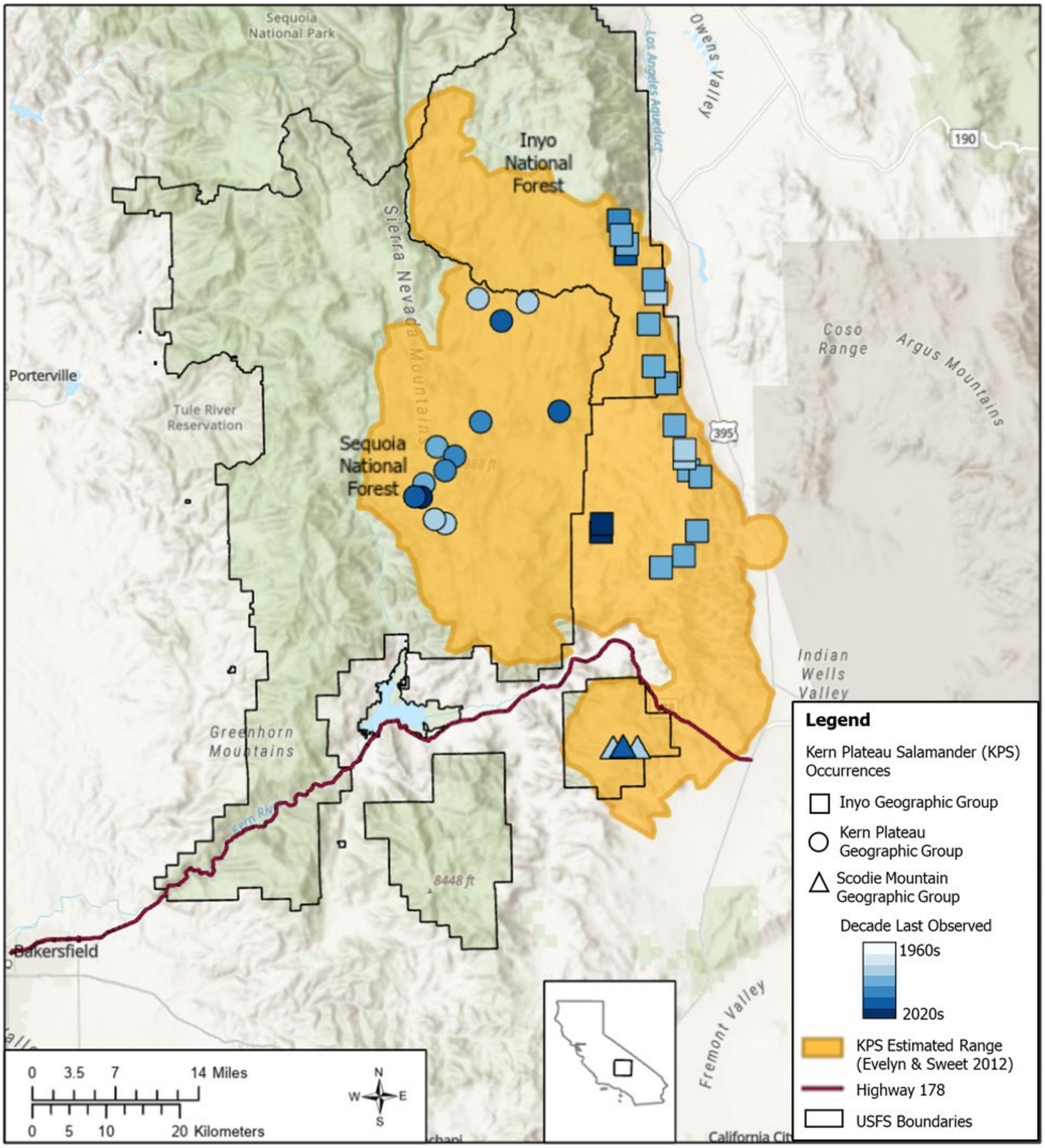

Figure A-3: The decade of the most recent observation of Kern Plateau salamanders at each site (CNDDB 2022, unpaginated).