From: Russell, Daniel
To: Deborah Giglio; Cat Darst; Eric Morrissette
Subject: Fwd: [EXTERNAL] Re: Request for Peer Review - Lesser Slender Salamander
Date: Monday, January 28, 2019 8:14:58 AM
Attachments: 20181220_Draft_LSS_SSA_CLEAN for PeerReview SS comments.docx

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FYI

****
Daniel Russell - Regional Listing Coordinator
Pacific Southwest Regional Office, Region 8
U.S. Fish and Wildlife Service
2800 Cottage Way, Room W-2606
Sacramento, CA 95825
Office (916) 978-6191
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****

---------- Forwarded message ---------
From: **Samuel Sweet** <goannafan@ucsb.edu>
Date: Wed, Jan 2, 2019 at 10:18 AM
Subject: [EXTERNAL] Re: Request for Peer Review - Lesser Slender Salamander
To: Russell, Daniel <daniel_russell@fws.gov>

Dear Mr Russell,

Thank you for the chance to review the draft Species Status Assessment Report for *Batrachoseps minor*. I have attached a copy here with my remarks in red. These correct a few minor errors and add a few items that I think might be helpful in supporting your conclusions. I agree with the report in its principal determinations. With respect to your specific questions:

(1) **Have we assembled and considered the best available scientific and commercial information relevant to this species?** Yes. The published information on *B. minor* (notably in the Lannoo volume) is seriously outdated, and the Service has retained and assembled all new information as it has received, as far as I know. These new data warrant a lot more optimism about the population trends and status of the species.

(2) **Is our analysis of this information correct?**
I believe that it is, with the few corrections I have noted in the text. The CBD petition was misinformed about a number of factors. Many things specific to *B. minor* remain unknown, but the report is fully justified in using inferences about these items based on related species of *Batrachoseps*, since there is little ecological variation in the genus. We do not have enough information about the effects of Bd for my taste, but the report correctly notes that the disease has been endemic in the range of *B. minor* for at least 5 decades, and that historic localities still support populations.

(3) **Are our scientific conclusions reasonable in light of this information?**
I believe that they are. Over the past 35 years I have principally advocated for the listing of western amphibian species (e.g., arroyo toads, red-legged and yellow-legged frogs, California tiger salamanders), but my familiarity with *B. minor* going back to 1971 (30 years before it was formally described) leads me to feel that there is no compelling rationale to list it, since it faces no serious threats, and certainly none that listing could help resolve.

I will close by noting that my lab group continues to monitor populations of *B. minor* and to seek additional populations, and that we keep the Service informed. I believe we have discovered a

ninth population near the historic Cuesta Ridge site a few days ago, but some subtle differences are leading me to seek genetic confirmation via Elizabeth Jockusch before making a definitive statement.

Sincerely,

Sam Sweet
Professor, EEM Biology eeand Curator of Herpetology,
Cheadle Center, University of California Santa Barbara

On Thu, Dec 20, 2018 at 12:33 PM Russell, Daniel <daniel_russell@fws.gov> wrote:

> Dear Dr. Sweet:
>
> The U.S. Fish and Wildlife Service (Service) is soliciting independent scientific reviews of the information contained in our 2018 draft Species Status Assessment Report for the Lesser Slender Salamander (*Batrachoseps minor*). Once finalized, this Species Status Assessment report (SSA report) will provide the underlying science on which we will base our decision on whether the species warrants listing as endangered or threatened under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.). You were identified by our Ventura Fish and Wildlife Office as a potential peer reviewer based on your area of expertise.
>
> This request is provided in accordance with our July 1, 1994, peer review policy (USFWS 1994, p. 34270) and our current internal guidance. This request also satisfies the peer review requirements of the Office of Management and Budget's "Final Information Quality Bulletin for Peer Review." The purpose of seeking independent peer review of the SSA is to ensure use of the best scientific and commercial information available; to ensure and maximize the quality, objectivity, utility, and integrity of the information upon which we base listing and recovery actions; and to ensure that reviews by recognized experts are incorporated into our final rulemaking processes. Please let us know if you would like us to provide any of the referenced materials to help facilitate your review.
>
> Please note that we are not seeking advice on policy or recommendations on the legal status of the species. Rather, we request that peer reviewers focus their review on identifying and characterizing scientific uncertainties, and on ensuring the accuracy of the biological and land and water use information in the SSA. Specifically, we ask peer reviewers to focus their comments on the following:
>
> (1) Have we assembled and considered the best available scientific and commercial information relevant to this species?
>
> (2) Is our analysis of this information correct?
>
> (3) Are our scientific conclusions reasonable in light of this information?
>
> Our updated peer review guidelines also require that all peer reviewers fill out a conflict of interest form. We will carefully assess any potential conflict of interest or bias using applicable standards issued by the Office of Government Ethics and the prevailing practices of the National Academy of Sciences (http://www.nationalacademies.org/coi/index.html). Divulging a conflict does not invalidate the comments of the reviewer; however, it will allow for transparency to the public regarding the reviewer's possible biases or associations. If we receive comments from a reviewer that we deem to have a substantial conflict of interest, we will evaluate the comments in light of those conflicts, and may choose not to give weight to those comments if the conflict is viewed as problematic. You may return the completed conflict of interest form either prior to or with your peer review.
>
> So that we may fully consider any input and coordinate other peer review comments as we develop the final SSA, and ensure adequate time to complete our 12-month finding, we are requesting peer review comments by January 10, 2019. If you are willing to peer review but are unable to complete your assessment during this time period, please let me know when we may anticipate receiving your comments. We will summarize and respond to the substantive comments raised by all peer reviewers and use the information, as appropriate, in the final SSA.
>
> While we welcome your peer review comments in any format you are most comfortable using, it would be especially helpful if you could use the attached Comment Matrix Excel spreadsheet.

This will make it easier to compile and keep a record of all the comments received and then incorporate them into our report. We would also appreciate receiving a copy of your Curriculum Vitae for our records. Please be aware that your completed review of the SSA, including your name and affiliation, will be included in the administrative record for this evaluation and will be available to interested parties upon request.

If you have any questions about the draft SSA report, or our listing policies in general, please feel free to contact me at any time at (916) 978-6191. Please submit your comments and associated materials to the contact information below, and you may also include the cc: list to this email in your reply.

Thank you very much for your consideration.

Sincerely,
Dan Russell

****

Daniel Russell - Regional Listing Coordinator
Pacific Southwest Regional Office, Region 8
U.S. Fish and Wildlife Service
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Draft

Lesser Slender Salamander (*Batrachoseps minor*) Species Status Assessment

An adult Lesser Slender Salamander from coastal south central California. Photo credit: Kenneth Wray

December 2018

ACKNOWLEDGEMENTS
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U.S. Fish and Wildlife Service. 2018. Species Status Assessment Report for the lesser slender salamander (*Batrachoceps minor)*. U.S. Fish and Wildlife Service, Pacific Southwest Region, Ventura, California.

EXECUTIVE SUMMARY

On July 11, 2012, we, the U.S. Fish and Wildlife Service (Service), received a petition from the Center for Biological Diversity requesting that 53 species of reptiles and amphibians, including the lesser slender salamander (*Batrachoseps minor*), be listed as endangered or threatened and that critical habitat be designated for these species under the Endangered Species Act. The petition states that lesser slender salamanders have become rare, and raises habitat loss, road mortality, climate change, and pesticide drift as potential threats to the species. On September 18, 2015, we published a 90-day finding that the petition presented substantial scientific or commercial information indicating that the petitioned action may be warranted (80 CFR 56427-56428). In September 2016, we published a 7-Year National Listing Workplan (https://www.fws.gov/endangered/what-we-do/listing-workplan.html), which called for completion of the status review for the lesser slender salamander by the end of September, 2019. In this Species Status Assessment, we evaluate the biological status of the lesser slender salamander, both currently and into the future, by considering the species' resiliency, redundancy, and representation. The scientific information presented here is for the purpose of informing our 12-month finding.

In 2001, the lesser slender salamander was described as a unique species based primarily on genetics, and also morphology. The lesser slender salamander is one of 21 species in the genus *Batrachoseps* (slender salamanders) in the Family Plethodontidae (lungless salamanders) that occur in California (plus one species that is limited to Oregon). The lesser slender salamander has the smallest average adult size of all slender salamanders and has a robust body and relatively long legs and short tail for its size when compared to other slender salamander species.

The lesser slender salamander has been observed in eight occurrence locations that occur entirely within the Santa Lucia Mountain Range in San Luis Obispo County, California. From north to south the occurrences are referred to as: (1) Las Tablas Ridge, (2) Black Mountain, (3) York Mountain, (4) Santa Rita Creek, (5) Toro Creek, (6) Cerro Alto, (7) Cuesta Ridge, and (8) Trout Creek. Two of the eight occurrence locations are on U.S. Forest Service Lands (Cerro Alto and Cuesta Ridge: Los Padres National Forest, Santa Lucia Ranger District); the other six occurrence locations are on private land. The lesser slender salamander is currently known to be present in all eight occurrence locations. Abundance data for the lesser slender salamander are not well known rangewide or at any of the eight occurrence locations.

Lesser slender salamanders require habitat comprised of terrestrial areas with small interstitial spaces needed to hide from predators and for feeding and that are moist to meet the species' requirements for breeding. A resilient lesser slender salamander population is one that is self-sustaining and has suitable habitat for feeding, breeding, and sheltering. Representation in the lesser slender salamander is the breadth of diversity across historical latitudinal, longitudinal, and elevation gradients, as well as climatic gradients. Lesser slender salamander redundancy contributes to the ability of the species to withstand catastrophic events (e.g., widespread drought, catastrophic wildfire, and flooding) which is related to the number, distribution, and resilience of populations.

We identified potential threats that could negatively affect lesser slender salamanders and thus pose a risk to resiliency, representation, and redundancy of the species We evaluated habitat loss, pesticide drift, road mortality, changing climate effects, and disease as potential threats to the lesser slender salamander and determined that changing climate and disease are the most likely threats to the species.

Current effects to the lesser slender salamander from increased temperatures due to changing climate include, but are not limited to: reduction of cool, moist areas that supply habitat and reduced survival of all life stages. During the daytime, Plethodontid salamanders inhabit moist places under rocks, bark, logs, within rotten wood, and in animal burrows, and they emerge at night when conditions are suitable. Slender salamanders use damp locations under logs, bark, and rocks, in leaf litter and termite galleries, and in crevices of rocks, logs, and stumps, suggesting that they may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. The species may continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a current population-level effect.

As for disease, *Batrachochytrium dendrobatidis* (Bd) has been found in lesser slender salamanders, however the vulnerability of the species to Bd infection and developing chytridiomycosis is unknown. Two congeners have differing susceptibility. In *B. attenuatus*, there is some level of susceptibility to infection, however it appears that Bd prevalence has been decreasing over time in this species. In contrast, *B. luciae* appears to be highly susceptible to wild Bd infection. While the lesser slender salamander has been shown to be susceptible to Bd, there are no data to suggest current die-offs. The species may continue to be affected by disease on the individual level, but we do not expect a current population-level effect.

At this time, the best available information indicates that the species is extant at seven of eight occurrence locations. These occurrence locations encompass the north-south and east-west gradients within its limited distribution, maintaining the relevant genetic diversity and associated adaptive capacity for the species that comprise representation. While redundancy will always be very limited for local, endemic species with a naturally limited range, it appears that the redundancy of the lesser salamander is sufficient.

We assessed likely change in climate and disease 25 years into the future. Projections of climate change along the central coast of California indicate that temperature will increase in the next 25 years. As for disease, we know that lesser slender salamanders have tested positive for Bd, but we do not know the species' vulnerability to Bd infection and developing chytridiomycosis. Bd appears to have been in California since the 1960s, peaked in the 1990s, and decreased since then.

We forecast the status of the lesser slender salamander after 25 years under two plausible future scenarios, one with continued climate-related effects and disease at the current level, and a second with continued climate-related effects and increased disease susceptibility. Under Scenario 1 (Climate and Disease Continuation), we found that lesser slender salamanders may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. If current trends in climate continue, the species may

continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a population-level effect in the next 25 years. As for disease, we determined that there may be decreased disease prevalence in the lesser slender salamander in the future, due to assumed similarity in disease susceptibility to *B. attenuatus*. Given that currently we do not anticipate that disease is population-level threat to the lesser slender salamander, at this continued level with disease susceptibility similar to *B. attenuates,* we do not anticipate a population-level effect in the next 25 years. We do not anticipate combined or synergistic effects of these threats under this scenario to pose population-level risk to the species into the future.

Under Scenario 2 (Climate Continuation and Increased Disease), the climate portion is the same as in Scenario 1 and therefore we anticipate that if current trends in climate continue, we do not anticipate a population-level effect in the next 25 years. As for potential increase in disease, under this scenario we assume greater susceptibility to Bd. It is possible that the lesser slender salamander has similar susceptibility to *B. luciae*, which appears to be highly susceptible to wild Bd infection. Based on the USGS findings that 2 of the occurrence locations tested were positive for Bd, in the next 25 years, we assume that approximately 2 of the 8 occurrence locations will have an associated mass die off and population declines due to Bd. This could decrease the resiliency of those 2 lesser slender salamander occurrence locations. The resiliency of the rest of the occurrence locations would not be affected. If there were extirpations, species representation and redundancy could be reduced.

In summary, under the first future scenario, occurrence location resiliency and species representation and redundancy would likely remain unchanged. Under the second future scenario, disease could act as a population-level threat to the species, but would not occur rangewide.

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1.0 INTRODUCTION

This report is the species status assessment (SSA) for the lesser slender salamander (*Batrachoseps minor*). We, the U.S. Fish and Wildlife Service (Service), developed this SSA for the lesser slender salamander to compile and evaluate the best available scientific information regarding the species' biology and factors that influence the species' viability.

1.1 Petition History

On July 11, 2012, we received a petition from the Center for Biological Diversity requesting that 53 species of reptiles and amphibians, including the lesser slender salamander (*Batrachoseps minor*), be listed as endangered or threatened and that critical habitat be designated for these species under the Endangered Species Act. The petition states that lesser slender salamanders have become rare and raises habitat loss, road mortality, climate change, and pesticide drift as potential threats to the species. On September 18, 2015, we published a 90-day finding that the petition presented substantial scientific or commercial information indicating that the petitioned action may be warranted (80 CFR 56427-56428). In September 2016, we published a 7-Year National Listing Workplan (https://www.fws.gov/endangered/what-we-do/listing-workplan.html), which called for completion of the status review for the lesser slender salamander by the end of September, 2019. In this Species Status Assessment, we evaluate the biological status of the lesser slender salamander, both currently and into the future, by considering the species' resiliency, redundancy, and representation. The scientific information presented here is for the purpose of informing our 12-month finding.

2.0 METHODOLOGY

As described in our guidance document, the SSA Framework (Service 2016a, entire), an SSA Report first begins with a compilation of the best available information on the species (taxonomy, life history, and habitat) and its ecological needs at the individual, population, and/or species levels based on how environmental factors are understood to act on the species and its habitat. Next, an SSA Report describes the current condition of the species' habitat and demographics, and the probable explanations for past and ongoing changes in abundance and distribution within the species' ecological settings (that is, areas representative of geographic, genetic, or life history variation across the range of the species). Lastly, an SSA forecasts the species' response to probable future scenarios of environmental conditions. An SSA uses the conservation biology principles of resiliency, representation, and redundancy (collectively known as the "3Rs", Shaffer and Stein 2000, pp. 308-311) as a lens through which we can evaluate the current and future condition of the species (Smith *et al*. 2018, entire). Ultimately, an SSA characterizes a species' ability to sustain populations in the wild over time based on the best scientific understanding of current and future abundance and distribution within the species' ecological settings.

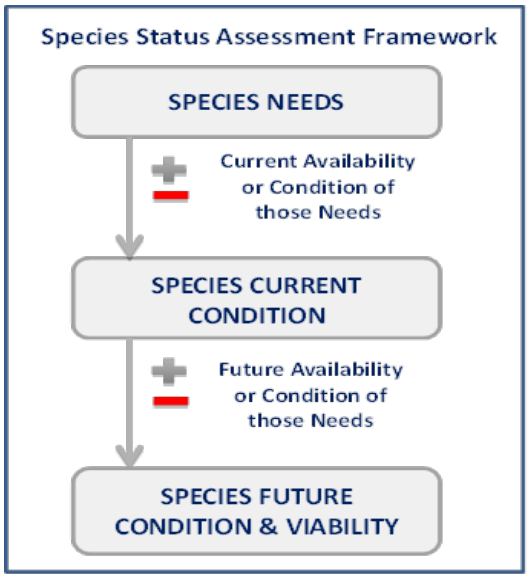


Figure 1. Species Status Assessment Framework

- Resiliency describes the ability of populations to withstand stochastic disturbance. Resiliency is positively related to population size and growth rate and may be influenced by connectivity among populations. Generally speaking, populations need abundant individuals within habitat patches of adequate area and quality to maintain survival and reproduction in spite of disturbance.

- Representation describes the ability of a species to adapt to changing environmental conditions over time. It is characterized by the breadth of genetic and environmental diversity within and among populations. Measures may include the number of varied niches occupied, the gene diversity, heterozygosity or alleles per locus.

- Redundancy describes the ability of a species to withstand catastrophic events. Redundancy is characterized by having multiple, resilient populations distributed within the species' ecological settings and across the species' range. It can be measured by population number, spatial extent, and degree of connectivity.

This document draws scientific information from resources such as primary peer-reviewed literature, reports submitted to the Service and other public agencies, species occurrence information in Geographic Information Systems (GIS) databases, and expert experience and observations. It is preceded by and draws upon analyses presented in other Service documents including the 90-day finding (Service 2015). Finally, we coordinated closely with our partners engaged in ongoing research. This assures consideration of the most current scientific and conservation status information.

3.0 SPECIES BACKGROUND

3.1 Taxonomy

The lesser slender salamander is one of 21 species in the genus *Batrachoseps* (slender salamanders) in the Family Plethodontidae (lungless salamanders) that occur in California (Highton *et al*. 2017, pp. 27-28).

In the early 1950s, there was thought to be one species of slender salamander throughout California; however, by the end of the decade multiple species of slender salamanders were recognized, and in 2001, the lesser slender salamander was described as a distinct species (Jockusch *et al*. 2001, pp. 54, 65-67). Jockusch *et al*. (2001, pp.65-66, 72-81) described morphological and genetic differences between the lesser slender salamander and other slender salamander species; however, slender salamanders are not easily differentiated through morphology alone.

3.2 Species Description

Slender salamanders are small, with bodies that are rounded with costal and caudal grooves similar in appearance to the body segments of earthworms, and with short limbs (Stebbins and McGinnis 2012, p. 124-125). Slender salamanders have four toes on both front and hind feet; all other western salamanders typically have four toes on front and five toes on hind feet (Stebbins 2003, p. 182). Slender salamanders can have a dorsal stripe of reddish, tan, or buff (Stebbins 2003, p. 182).

The lesser slender salamander has the smallest average adult size of all slender salamanders, with a snout-to-vent range of 2.5 to 4.6 cm (1 to 2.3 in.) (Stebbins and McGinnis 2012, p. 137). Although small in size, the species has a robust body and relatively long legs but a short tail for its size when compared to other slender salamander species (Stebbins and McGinnis 2012, p. 137). Coloring of lesser slender salamanders is dark blackish brown above and a dorsal stripe may or may not be present, which can be tan with pink to apricot highlights especially prominent in the tail (Stebbins 2003, p. 191). Individuals usually have orange thighs, and their skin displays a matte finish (not shiny) in comparison to other slender salamander species resident in coastal central California.

3.3 Genetics

Jockusch *et al*. (2001, entire) analyzed morphology, allozymes, and mitochondrial DNA of individual lesser slender salamanders collected from two locations in San Luis Obispo County, California, and individuals of other species of slender salamanders from other areas within Monterey, San Luis Obispo, Santa Cruz, San Benito, Fresno, and Kern Counties in California. Their analyses resulted in the description of four new slender salamander species that were previously treated as a single species, *B. pacificus*.

The lesser slender salamander resides in the *B. pacificus* species group (Wake and Jockusch 2000, p. 100), which is comprised of six slender salamander species that reside in three geographically disjunct units in coastal California (Jockusch *et al*. 2001, p. 83). These six species are: *B. minor*, *B. pacificus*, *B. major*, *B. luciae*, *B. incognitus*, and *B. gavilanensis*.

Slender salamanders (*Batrachoseps* spp.) are extremely sedentary as evidenced by the extensive differentiation across relatively small geographic areas (Jockusch *et al*. 2001, pp. 81-83). Based upon cytochrome *b*, divergence time estimates of lesser slender salamander separation from its closest geographically located congeners in the *B. pacificus* group are, in millions of years before present: *B. luciae* 17.3-6.9, *B. incognitus* 9.8-3.9, and *B. gavilanensis* 16.3-6.5 (Jockusch *et al*. 2001, pp. 86-87). Additionally, the lesser slender salamander is allopatric from these three species.

The lesser slender salamander is sympatric (occurring within the same geographical area of another species, overlapping in distribution) with another slender salamander species, *B. nigriventris* (Jockusch *et al*. 2001, p. 86), but they are paraphyletic (species descended from a common evolutionary ancestor or ancestral group, but not sharing/including all of the ancestor's descendant groups) (Jockusch *et al*. 2001, p. 82), as *B. nigriventris* resides in the *B. relictus* (*see below) species group (Jockusch *et al*. 1998, p. 14). Additionally, they do not share niches within coinciding areas of similar habitat (e.g., oak woodland). The lesser slender salamander is typically found on heavily-shaded slopes with rocky outcrops, with a dense understory of poison oak, while *B. nigriventris* is typically found in more open woodlands on flatter ground with a dense cover of leaf litter and grasses (S. Sweet pers. comm. 2017). The two species may occur within 3 m of one another along habitat boundaries.

3.4 Summary – Species Background

In 2001, the lesser slender salamander was described as a unique species based primarily on genetics, and also morphology (Jockusch *et al*. 2001, entire). The lesser slender salamander is 1 of 21 species of slender salamanders that occur in California. The species has the smallest average adult size of all slender salamanders and has a robust body and relatively long legs with orange thighs and short tail for its size when compared to other slender salamander species.

4.0 HISTORICAL ABUNDANCE, RANGE, AND DISTRIBUTION

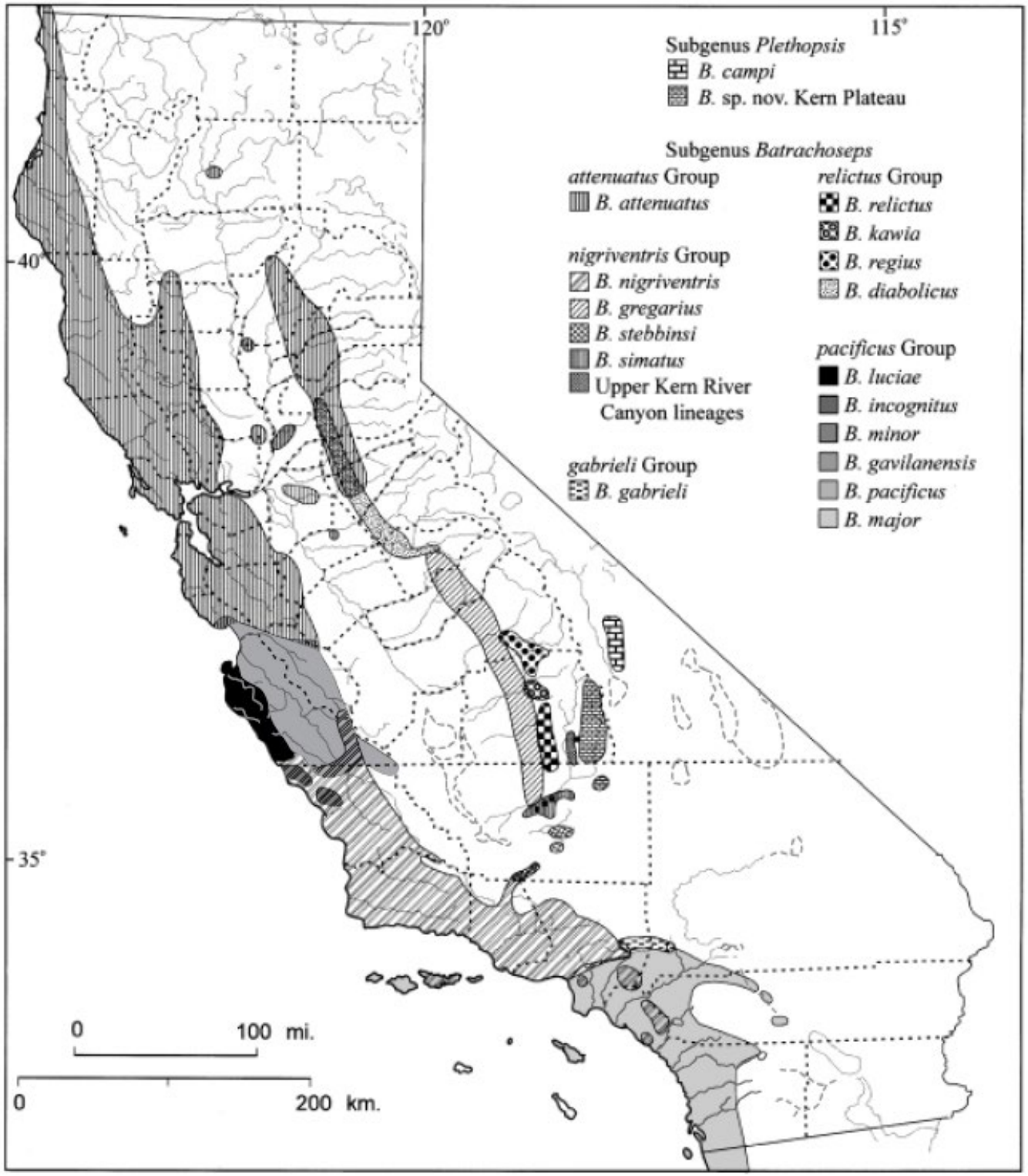
4.1 Range

Slender salamanders in the genus *Batrachoseps* range almost continuously along the Pacific Coast from about 62 miles (100 km) north of the California border in Curry County, Oregon, to about 186 miles (300 km) south of the California border near El Rosario, Baja California Norte, Mexico (Jockusch *et al*. 2001, pp. 54-55.)

The range of the lesser slender salamander extends less than 30 linear miles, and it occurs entirely within the Santa Lucia Mountain Range in San Luis Obispo County, California (Jockusch *et al*. 2001, p. 66).(add Sweet pers,. comm. 2017?)

(****) Now recast as the nigriventris group, see E. L. Jockusch, I. Martinez-Solano, R.W. Hansen, & D. B. Wake. 2012. Morphological and molecular diversification of slender salamanders (Caudata: Plethodontidae: *Batrachoseps*) in the southern Sierra Nevada of California with descriptions of two new species. Zootaxa 3190**:**1-30.

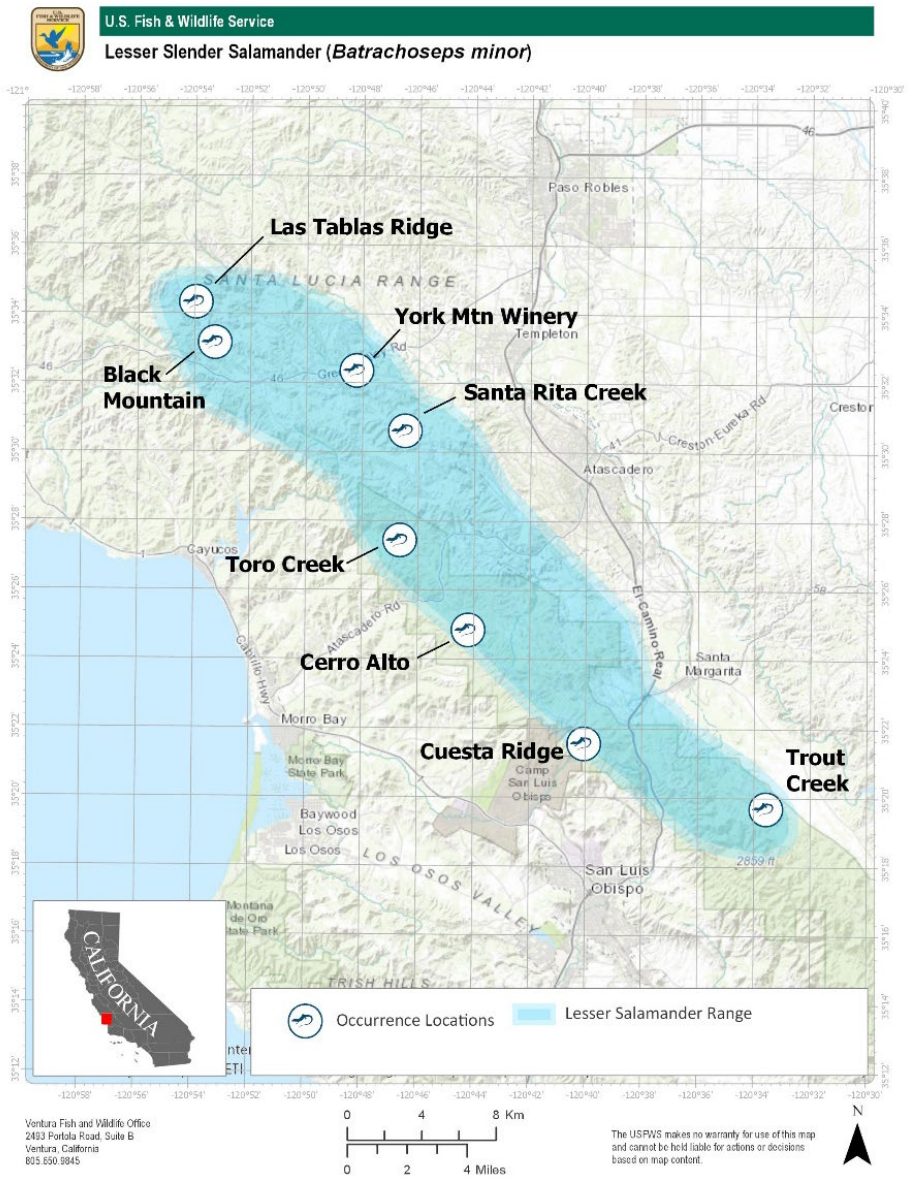
Figure 2. Distribution of 18 described species and several lineages corresponding to undescribed species of *Batrachoseps* in California from Jockush and Wake (2002, p. 364). Note that *B. minor* is geographically distinct from other species in the *pacificus* group, but its range overlaps with that of *B. nigriventris* of the *nigriventris* group. This map does not include Sierran species from Jockusch et al 2012.



4.2 Distribution

Eight occurrences of the lesser slender salamander have been found at locations along the Santa Lucia Range in San Luis Obispo County, California. From north to south the occurrence locations are referred to as: (1) Las Tablas Ridge, (2) Black Mountain, (3) York Mountain, (4) Santa Rita Creek, (5) Toro Creek, (6) Cerro Alto, (7) Cuesta Ridge, and (8) Trout Creek (S. Sweet pers. comm. 2017.). We define "occurrences locations" as the locality where lesser slender salamanders have been found. Two of the 8 occurrence locations are on U.S. Forest Service Lands (Cerro Alto and Cuesta Ridge: Los Padres National Forest, Santa Lucia Ranger District); the other 6 occurrence locations are on private land. The Cuesta Ridge site is based on a single specimen collected (1972) prior to a devastating wildfire (1994), and efforts to relocate the species at that site since then have failed,

Figure 3. Eight occurrence locations of *B. minor* as described by Dr. Samuel Sweet of University of California, Santa Barbara, in August 2017.



The Las Tablas Ridge occurrence location is near Cypress Mountain Road, which is west of U.S. 101 and north of California Highway 46, and is on private land.

The Black Mountain occurrence location is along north facing slopes in the vicinity of Black Mountain, which is west of U.S. 101 and north of California Highway 46, and is on private land.

The York Mountain occurrence location is along northeast facing slopes adjacent to York Mountain Road, which is west of U.S. 101 and north of California Highway 46, and is on private land.

The Santa Rita Creek occurrence location is along north facing slopes adjacent to Santa Rita Creek Road, which is west of U.S. 101 and east of Old Creek Road, and is on private land. At

present, this is the most extensive occurrence comprised of multiple locations where lesser slender salamanders have been observed. (S. Sweet pers. comm. 2015).

The Toro Creek occurrence location is along the old Highway 41, which is west of U.S. 101 and north and west of (current) California Highway 41, and is on private land but within the Los Padres National Forest boundary.

The Cerro Alto occurrence location is within a U.S. Forest Service recreation area of the Los Padres National Forest, Santa Lucia Ranger District, with a campground and hiking trails, which is west of U.S. 101 and south of California Highway 41. There is no Forest Service management plan in place for the Los Padres that includes amphibian management. There is a forest-wide management plan that outlines general approaches to forest management, and management plans are developed on a project-by-project basis (Cooper pers. comm. 2018).

The Cuesta Ridge occurrence location is at the Cuesta Ridge Botanical Reserve on U.S. Forest Service lands, Los Padres National Forest, Santa Lucia Ranger District, which is west of U.S. 101 and south of California Highway 41.

The Trout Creek occurrence location is along northwest facing slopes adjacent to a forest road near the junction of Water Canyon and Trout Creek, which is east of U.S. 101 and south of California Highway 58, and is on private land but within the Los Padres National Forest boundary.

4.3 Abundance

The abundance of lesser slender salamanders is not well known rangewide or at any of the occurrences. Surveys for lesser slender salamanders have been irregular since the 1970s and we are not aware of any studies having been conducted to estimate lesser slender salamander abundance that would inform trends in the numbers of individuals in any occurrence over time.

4.4 Summary – Historical Range, Distribution, and Abundance

The lesser slender salamander has been observed in eight occurrence locations that occur entirely within the Santa Lucia Mountain Range in San Luis Obispo County, California. Two of the 8 occurrence locations are on U.S. Forest Service Lands (Cerro Alto and Cuesta Ridge: Los Padres National Forest, Santa Lucia Ranger District); the other 6 occurrence locations are on private land. Abundance data for the lesser slender salamander is not well known rangewide or at any of the eight occurrences.

5.0 LIFE HISTORY

5.1 Breeding

Little is known specifically about lesser slender salamander breeding; however, information is available for the plethodontid family and *Batrachoseps* genus of slender salamanders.

Many plethodontid salamanders (including all western North American species) reproduce on land and do not require an aquatic larval phase (Stebbins and McGinnis 2012, p. 104). This is attributed to the egg's large yolk in which the embryo goes through the gilled larval stage to hatch as a miniature adult (Stebbins and McGinnis 2012, p. 104). Slender salamander (*Batrachoseps* spp.) eggs are fertilized internally, and when laid, are connected to one another by filaments resembling a string of beads (Stebbins and McGinnis 2012, p. 106). Most slender salamanders (*Batrachoseps* spp.) lay their eggs in fall, after the first rains that end the summer dry period, and embryos develop over the winter months (Stebbins and McGinnis 2012, p. 105, 125). Eggs require a damp, concealed location that will remain moist over the several-month development period (Stebbins and McGinnis 2012, p. 104). A moist egg capsule is needed for the passage of oxygen to the gills of the embryo, which are pressed against the inner surface of the egg capsule (Stebbins and McGinnis 2012, p. 65). The nest site is usually a moist rock crevice, under bark of a rotting log, or a ground cavity (Stebbins and McGinnis 2012, p. 64). Suitable microsites are apparently deep underground, as clutches are rarely found and unknown for most species.

5.2 Life Cycle

The lesser slender salamander life cycle is comprised of an egg, juvenile, and adult. There are no data specific to the details of the life cycle of the lesser slender salamander. Maiorana (1976, entire) examined the life-history patterns of *Batrachoseps attenuatus* and reported that at the beginning of their first dry season, hatchlings are approximately one-tenth the weight of an average adult and therefore may have lower survival rates than adults through periods of prolonged drought and reduced food sources (Maiorana 1976, p. 605). She also reported that in woodland habitat, 95% of adult female *B. attenuatus* reproduce each year and lay 7 to 8 eggs, and maturity is at 2.5 years (3 dry seasons). Data on longevity were not available, but a long adult life was suggested, potentially up to 6 years (Maiorana 1976, p. 605-606).

5.3 Feeding

Slender salamander (*Batrachoseps* spp.) food includes newly hatched earthworms (Class Oligochaeta), small slugs (Class Gastropoda), spiders (Class Arachnida), large mites (Class Arachnida), juvenile snails (Class Gastropoda), millipedes (Class Diplopoda), sowbugs (Order Isopoda), and other small invertebrates that inhabit surface-litter areas and subterranean openings (Stebbins and McGinnis 2012, p. 127).

5.4 Sheltering

Little is known specifically about lesser slender salamander sheltering; however, information is available for the plethodontid family and *Batrachoseps* genus of slender salamanders. During the daytime, plethodontid salamanders inhabit moist places under rocks, bark, logs, within rotten wood, and in animal burrows, and they emerge at night when moisture conditions are suitable (Stebbins 2003, p. 168). Slender salamanders (*Batrachoseps* spp.) have been found in damp locations under logs, bark, and rocks, in leaf litter and termite galleries, and in crevices of rocks, logs, and stumps (Stebbins 2003, p. 183). *Batrachoseps minor* favor smaller logs and pieces of bark that rest lightly on the surface, as opposed to being partly embedded in soil. They retreat

from the surface as the leaf litter dries out, and in response to overnight temperatures at or below freezing.

5.5 Summary – Life History

Lesser slender salamanders reproduce on land and do not require an aquatic larval phase. Eggs are laid in concealed, damp locations that will remain moist for the duration of embryo development. At hatching, lesser slender salamander juveniles are similar to adults in morphology but smaller in body size. Lesser slender salamanders feed on a variety of small invertebrate prey found under logs and rocks or in the other small crevices and underground shelters in which they reside.

6.0 GENERAL HABITAT DESCRIPTION

Habitat for the lesser slender salamander is comprised of shaded slopes with deep leaf litter and an abundant understory of poison oak (*Toxicodendron diversilobum*) (Jockusch *et al*. 2001, p. 66). The species occurs in wooded habitats containing tanbark oak (*Notholithocarpus densiflorus*), coast live oak (Q*uercus agrifolia*), blue oak (*Quercus douglasii*), sycamore (*Platanus racemosa*), and California laurel (*Umbellularia californica*) (Stebbins and McGinnis 2012, p. 137), and with abundant lower story vegetation dominated by poison oak (Jockusch *et al*. 2001, p. 66). The lesser slender salamander prefers closed-canopy northward facing steeper slopes with rock outcrops and shallow soil (S. Sweet pers. comm. 2017) and are typically found at an altitude above 1300 feet (400m) (Jockusch *et al*. 2001, p. 66). Known sites range from 850-2180 feet (260-660m}, but the species mostly selects habitat types that occur on the middle third of local ridges at 300-400 m.

7.0 SPECIES NEEDS

7.1 Individual Needs

Lesser slender salamanders require habitat comprised of terrestrial areas with small interstitial spaces, such as earthworm burrows, rock crevices, or under wooden debris (logs). These small spaces allow individuals to hide from larger predators and also provide the small invertebrate prey needed by lesser slender salamanders for feeding. Moist areas within lesser slender salamander habitat are required for breeding to maintain moisture for developing embryos within eggs and required by individuals to avoid desiccation over the typically long periods without rainfall (California summer).

7.2 Population Needs

Population dynamics of the lesser slender salamander are not well understood. Lesser slender salamander populations need suitable habitat that supports survival of individuals and an adequate number of reproducing individuals with vital rates that maintain self-sustaining populations despite stochastic events.

7.3 Species Needs

The lesser slender salamander needs multiple resilient populations distributed across the range of the species.

7.4 Resiliency, Representation, and Redundancy

Resiliency

Resiliency describes the ability of the populations to withstand stochastic events. Measured by the size and growth rate of each population, resiliency gauges the probability that the populations comprising a species are able to withstand or bounce back from environmental or demographic stochastic events.

Lesser slender salamander population-level resiliency is a function of its size and its growth rate. A resilient lesser slender salamander population is one that is self-sustaining and has suitable habitat for feeding, breeding, and sheltering.

Representation

Representation describes the ability of a species to adapt to changing environmental conditions. Measured by the breadth of genetic or environmental diversity within and among populations, representation gauges the probability that a species is capable of adapting to environmental changes.

Representation in the lesser slender salamander is important across the range of the species. Although we expect local endemics, such as the lesser slender salamander, to naturally harbor less adaptive capacity than wide-ranging species. Species that span environmental gradients (spatially and temporally heterogeneous environments) are expected to harbor the most phenotypic and genetic variation (Lankau *et al*. 2011, p. 320). Thus, preserving the breadth of diversity of a species requires maintaining populations across historical latitudinal, longitudinal, and elevation gradients, as well as climatic gradients. We do not have information on the genetic diversity for lesser slender salamanders but assume that maintenance of resilient occurrences across the north-south and east-west gradients within its historically limited distribution is representation for the species.

Redundancy

Redundancy describes the ability of a species to withstand catastrophic events. Measured by the number of populations, their resiliency, and their distribution (and connectivity), redundancy gauges the probability that the species has a margin of safety to withstand or can bounce back from catastrophic events.

Lesser slender salamander redundancy is a function of the number and distribution of resilient populations across the range relative to the degree and spatial extent of potential catastrophic events. Distribution is related to the number of occurrences. Catastrophic events which could affect lesser slender salamander occurrences include disease, widespread drought and periods of

extreme heat resulting in the loss of soil moisture in lesser slender salamander habitat, catastrophic wildfire, and torrential rainstorms resulting in sediment/debris flows or widespread flooding.

7.5 Summary -- Species Needs

Lesser slender salamanders require habitat comprised of terrestrial areas with small interstitial spaces needed to hide from predators and for feeding, and that are moist to meet the species' requirements for breeding. A resilient lesser slender salamander population is one that is self-sustaining and has suitable habitat for feeding, breeding, and sheltering. Representation in the lesser slender salamander is maintained by preserving the breadth of diversity across historical range. Lesser slender salamander redundancy is a function of the number and distribution of resilient populations across the range relative to the degree and spatial extent of potential catastrophic events, such as disease, widespread drought, wildfire, and flood effects.

8.0 CURRENT CONDITIONS

8.1 Abundance and Distribution

Prior to 2015, the lesser slender salamander was known to occur in six locations. Since that time, two additional locations have been discovered. The lesser slender salamander is currently known to be present in seven of eight occurrence locations (S. Sweet pers. comm. 2017).

The Las Tables Ridge, Black Mountain, York Mountain, Santa Rita Creek (from where the holotype was collected in 1975), Cerro Alto, and Cuesta Ridge are historical occurrence locations (Jockusch *et al*. 2001, p. 65-66 page #s are incorrect).

Individual lesser slender salamanders were observed at Las Tablas Ridge, Black Mountain, York Mountain, and Santa Rita Creek, occurrences annually between 2011 and 2018 (S. Sweet pers. comm. 2019). The Cuesta Ridge (1972) and Cerro Alto (2008) records are single specimens with no subsequent observations.

The Toro Creek occurrence was discovered in 2016 (S. Sweet pers. comm. 2017) and the Trout Creek occurrence was discovered in 2015, and have been observed there each year since (S. Sweet pers. comm. 2019).

Current abundance for the lesser slender salamander at each occurrence is unknown. The data required to make abundance estimates for each occurrence are lacking and therefore population estimates cannot be made at this time.

Table 1. Historic and current distribution of *B. minor*

Occurrence	Historic	Current
Las Tables Ridge	X	Present in 2011-2018
Black Mountain	X	Present in 2011-2018
York Mountain	X	Present in 2011-2018
Santa Rita Creek	X	Present in 2011-2018
Cerro Alto	X	Not seen since 2008

Cuesta Ridge	X	Not seen since 1972
Toro Creek	--	Discovered in 2016
Trout Creek	--	Discovered in 2015

We evaluated potential threats to the lesser slender salamander, including habitat loss, pesticide drift, road mortality, climate change, and disease. We evaluated overutilization, collection, and predation to see if they were actually occurring or were a significant problem, and we did not find any information to indicate that they are a concern for the lesser slender salamander now or into the future.

Dr. Samuel Sweet, Professor, University of California, Santa Barbara, conducted graduate work on the lesser slender salamander in the 1970s and in the winter of 2011 began to reinvestigate the status of the species. According to Dr. Sweet, lesser slender salamanders were easily found recently at most recorded localities and numbers may be reduced compared to the 1970s, but this is true for all plethodontid (lungless) salamanders in central California as a consequence of extended drought, but more generally as a result of a long-term climatic shift driven by the Pacific Decadal Oscillation.

Dr. Sweet provided the following related to threats to the species (S. Sweet pers. comm. 2015):

- Habitat loss—In the areas inhabited by lesser slender salamanders there has been no habitat change of any kind in over 45 years. York Mountain Vineyards and Winery have not farmed grapes on site since its main building was destroyed in the 2003 San Simeon earthquake, and only recently (2015) replanted in the original footprint.

- Pesticide drift—Lesser slender salamanders living nearby the winery do not seem to be affected.

- Road mortality—In the California Roadkill Observation System, as of September 27, 2015, no roadkill of lesser salamanders has been reported.

- Climate change—This is a major factor for all native amphibians in California.

- Disease—The fungal disease, *Batrachochytrium dendrobatidis* (Bd), may be affecting the lesser slender salamander (S. Sweet pers. comm. 2017).

The Service accessed *AmphibiaWeb* on March 27, 2017 (http://amphibiaweb.org/cgi/amphib_query?where-genus=Batrachoseps&where-species=minor), which states: "Fewer than five of these [lesser slender] salamanders have been seen in the past decade despite many attempts to find them. Although some areas within the historical range of this species have been modified for agriculture (i.e., conversion to vineyards), ample habitat remains and there is no obvious reason for this decline in abundance." Although land was converted several decades ago for the York Mountain Vineyards and Winery, this land conversion occurred adjacent to, but not within, habitat for the lesser slender salamander.

We have been unable to find any data suggesting that pesticide drift is a threat to the lesser slender salamander or its habitat. While there are many vineyards east of the Santa Lucia crest in central San Luis Obispo County and the number is growing, there is a climatic line 2-5 km east of all known *B. minor* localities, termed the 'fog line', west of which it is too damp to grow wine grapes.

The Service accessed the California Roadkill Observation System (http://www.wildlifecrossing.net/california/) on August 21, 2018, and found no records documenting road mortality of lesser slender salamanders (or any other slender salamander species). Our search corroborates the information provided by Dr. Sweet regarding the lack of data supporting road mortality as a threat to lesser slender salamanders. The CBD petition also listed "road-building and improvements" as a threatening factor, but all known localities are on or along minor roads with minimal current maintenance. New roads (US hwys 41 and 46) bypass these older routes in providing connections between the Salinas Valley and the coast, and there is no evident reason to significantly modify the older roads.

Batrachochytrium dendrobatidis (Bd) is a fungal pathogen which can cause chytridiomycosis, a highly infectious amphibian disease associated with mass die-offs, population declines and extirpations, and potentially species extinctions on multiple continents (Berger *et al*. 1998, pp. 9031-9036; Bosch *et al*. 2001, pp. 331-337; Lips *et al*. 2006, pp. 3165-3166).

The best available information we have regarding the lesser slender salamander has led us to determine that we need to consider further how climate change and disease are impacting the viability of the lesser slender salamander in this SSA now and into the future.

8.3 Potential Threats

8.3.1 Changes in Climate Conditions

The summer of 2017 was the warmest in California since record keeping began in the late 1800's (not a possessive, but a plural, no apostrophe) (NOAA National Centers for Environmental Information 2018). Considering data up to 2015, Brown *et al*. (2016, entire) reported that most of the warming occurred in the past 35 years with 15 of the 16 warmest years occurring since 2001. The 3-year period from 2012 to 2014 was the hottest and driest in California in the 100-year timeframe considered (Mann and Gleick 2015, p. 3858), and it was the most severe drought in California in the past 1,200 years (Griffin and Anchukaitis 2014, p. 9017). According to Thorne *et al*. (2017, entire), this trend appears likely to continue; however recent projections for California indicate that while temperatures will significantly increase, no significant change in precipitation is predicted (He *et al*. 2018, entire). Also, He *et al*. (2018, p. 17) reports a decreasing tendency for severe droughts.

The lesser slander salamander is a Priority 2 (out of 3) taxon for drought vulnerability based on the California Department of Fish and Wildlife's rapid assessment of the vulnerability of sensitive California wildlife to extreme drought (CDFW 2016, p. 28). Drought vulnerability was assessed for special status amphibians, reptiles, birds, and mammals using scores for three risk categories and three life history/status criteria. Priority 1 were those taxa found to be most

vulnerable to extended or frequent severe drought and resultant risk of extirpation. Priority 2 was created to capture taxa that have an elevated drought risk but do not meet the conditions of high priority taxa, which were placed in Priority 1. Priority 3 included all other taxa evaluated with lower drought risk.

Current effects to the lesser slender salamander from increased temperatures due to climate change include, but are not limited to: reduction of cool, moist areas that supply habitat and reduced survival of all life stages. During the daytime, plethodontid salamanders inhabit moist places under rocks, bark, logs, within rotten wood, and in animal burrows, and they emerge at night when conditions are suitable. Slender salamanders use damp locations under logs, bark, and rocks, in leaf litter and termite galleries, and in crevices of rocks, logs, and stumps, suggesting that they may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. The species may continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a current population-level effect.

8.3.2 Disease

Disease has the potential to cause catastrophic loss of lesser slender salamanders. There are two pathways by which disease could result in a catastrophic mortality event for the lesser slender salamander. Mortality events could be caused by existing pathogens or through the introduction of novel pathogens.

The chytrid fungus *Batrachochytrium dendrobatidis* (Bd) was identified in 1999 and has been attributed to the primary cause of decline for many amphibians. Bd is a fungal pathogen that can cause chytridiomycosis and it has been documented in wild lesser slender salamander individuals. A second type of chytrid fungus (*Batrachochytrium salamandrivorans*, Bsal) is emerging in Europe. While Bsal primarily affects salamanders, frogs can also become infected and spread this disease. Additionally, the disease Ranavirus has been documented in northern California but has not been observed in lesser slender salamanders, but could be spread into the range of the lesser slender salamander.

Given the high risk of *Bsal* invasion, the Service recently listed 20 amphibian genera known to carry *Bsal* as injurious under the Lacey Act to limit importation into the United States (USFWS 2016, entire). Despite this protection, it is possible that an unknown carrier or illegal import could introduce this pathogen into salamander populations in California.

Emerging infectious diseases (EIDs) have been increasing in large part because of globalization and the increased frequency and rapidity of international travel and trade (McLean 2007, p. 262; Brand 2013, p. 447; Smith *et al*. 2017, pp. 30-31). Global wildlife trade is a significant contributor and occurs mostly through uncontrolled or illegal networks, and involves millions of birds, mammals, reptiles, amphibians, and fish every year (Karesh *et al*. 2005, p. 1000; Smith *et al*. 2017, pp. 30-31). Increasingly, disease is being recognized as a driver of population declines and extinctions (Brand 2013, p. 447; McPhee and Greenwood 2013, p. 6), and amphibians are one of the vertebrate groups most negatively impacted by the introduction of EIDs world-wide (Martel *et al*. 2014; Chambouvet *et al*. 2015; Berger *et al*. 2016, entire).

Batrachochytrium dendrobatidis

Batrachochytrium dendrobatidis (Bd) is a fungal pathogen which can cause chytridiomycosis, a highly infectious amphibian disease associated with mass die-offs, population declines and extirpations, and potentially species extinctions on multiple continents (Berger *et al*. 1998, pp. 9031-9036; Bosch *et al*. 2001, pp. 331-337; Lips *et al*. 2006, pp. 3165-3166). Bd attacks the keratinized tissue of amphibian skin and can lead to thickened epidermis, lesions, body swelling, lethargy, loss of righting reflex, and death in all life stages (Berger *et al*. 1998, pp. 9031-9036; Bosch *et al*. 2001, p. 331; Carey *et al*. 2003, p. 130). Chytridiomycosis infection rates among amphibians exposed to Bd vary by species (Woodhams *et al*. 2007, p. 4), and resistance to Bd infection in some amphibians is likely related to levels of antimicrobial peptides found in skin secretions (Woodhams *et al*. 2007, p. 4), beneficial skin bacteria (Harris *et al*. 2006, p. 55), and possibly frequent skin shedding (Woodhams *et al*. 2007, p. 6). The effects of chytridiomycosis can vary among host species and life stages (Gervasi *et al*. 2013) and can even vary between populations of the same species (Bradley *et al*. 2015). Resistance can be reversed under certain environmental conditions, for example those that can exert stress and immunosuppression (Ramsey *et al*. 2010). Thus, the prevalence of Bd (i.e., number of positives/number sampled) in different populations is likely reflecting the interaction between the host, the pathogen strain, and the environmental conditions they encounter (Spitzen-Van der Sluijs *et al*. 2014; Bacigalupe *et al*. 2017).

Lesser slender salamanders are susceptible to contracting chytrid. The U.S. Geological Survey (USGS) conducted an analysis of samples collected in 2017 from eight individual lesser slender salamanders. Their provisional results for Bd in lesser slender salamanders determined that, of the three occurrence locations from which samples were taken, all samples from two of the occurrence locations (Toro Creek and Santa Rita Creek) were Bd positive, while those from Trout Creek were negative for Bd (R. Fisher pers. comm. 2018).

The prevalence of Bd in lesser slender salamanders is not known; however, a study was conducted on another slender salamander species that occurs in California, *B. attenuates* (Sette *et al*. 2015, entire). Sette *et al*. (2015) found Bd infection and spread in *B. attenuatus* in proximity to the greater Bay Area of northern California. From the museum specimens used in their study, Bd was first found in *B. attenuatus* during the 1960s (Sette *et al*. 2015, p. 24). Bd prevalence in *B. attenuatus* peaked in the 1990s, and in 2013 the prevalence of Bd in *B attenuatus* had decreased from the levels found in the 1990s (Sette *et al*. 2015, pp. 24-25).

The effects of Bd infection on lesser slender salamanders are not known; however, studies on the effects of Bd to two other slender salamander species that occur in California, *B. attenuatus* and *B. luciae*, have been conducted. Weinstein (2009, entire) conducted studies investigating the effects of Bd on *B. attenuatus*. Under one study, Weinstein (2009, p. 655) collected 30 living individuals of *B attenuatus* from the wild, 19 of which were determined to have been infected with Bd in the wild; 18 (95%) died within 70 days and all of the individuals infected with Bd died in the lab over the course of the approximate 120-day study, while 10 of 11 uninfected individuals survived. In a second study, Weinstein (2009, pp. 654-657) collected individuals of *B. attentuatus* from the wild and infected them with Bd in the lab; those held in the experimental

dry conditions (95% relative humidity) began reducing their zoospore counts after inoculation and all individuals lost their infections and survived more than 95 days. This suggests that slender salamanders could shed Bd infection during dry periods. Sparagon (2015) examined Bd susceptibility in individuals carrying wild Bd infections and individuals inoculated with lab grown Bd. Experiments demonstrated significant differences in *B. luciae* mortality rates from wild Bd and lab grown Bd infections. Those with wild infections had a 77.8% mortality rate; those infected in the lab had a 25% mortality rate, suggesting that *B. luciae* is susceptible to infection and death from wild Bd (Sparagon 2015, pp. 20-25).

The details of how Bd moves through the environment resulting in the spread of disease is not well understood, but could occur through reservoir species (Reeder *et al*. 2012, pp. 4-5). The Pacific chorus frog (*Pseudacris regilla*) is common and widespread across California (Stebbins and McGinnis 2012, pp. 180-181). Pacific chorus frogs can withstand high Bd zoospore loads without symptoms or mortality (Reeder *et al*. 2012, pp. 2-3). Additionally, four species of Pacific newts (Genus *Taricha*) are common and widespread across coastal California (Stebbins and McGinnis 2012, pp. 92-103) and may serve as a reservoir for chytridiomycosis in terrestrial salamanders (Chaukulkar *et al*. 2018, p. 6). Infected bullfrog (*Rana catesbiana*) tadpoles can also be effective vectors of Bd (Miaud *et al*. 2016, entire). Lesser slender salamanders do not have an aquatic phase, unlike Pacific chorus frogs and Pacific newts which require an aquatic larval phase, and the ability for Bd zoospores to survive can be reduced in dry terrestrial environments, potentially lessening the likelihood of Bd spread from reservoir species with an aquatic life stage to slender salamanders.

Batrachochytrium salamandrivorans

The fungal pathogen Bsal invaded Europe from Asia around 2010 and is responsible for causing mass die-offs of fire salamanders (*Salamandra salamandra*) in northern Europe (Martel *et al*. 2014, p. 631; Fisher 2017, p. 300-301). Given unregulated trade and the recent discovery of Bsal in amphibians, there is concern about the introduction of a novel pathogen causing extirpations of salamander populations in North America which have never been exposed to the disease (Yap *et al*. 2017, entire). While we still do not have a clear understanding of all of the salamander species that will be susceptible to Bsal, there is concern that lesser slender salamanders could be impacted. The Pacific coast, including the range of the lesser slender salamander, is one the regions with the highest risk of introduction of Bsal (Richgels *et al*. 2016, p. 5; Yap *et al*. 2015, p. 482) and highest risk of Bsal to native salamanders (Richgels *et al*. 2016, p.6).

Given the high risk of Bsal invasion, the Service recently listed under the Lacey Act 20 amphibian genera known to carry Bsal as injurious, in order to limit importation into the United States (Service 2016b, entire). The USGS conducted an analysis of samples collected in 2017 from eight individual lesser slender salamanders. Their provisional results for Bsal determined that of the three occurrence locations from which samples were taken, all samples were negative for Bsal (R. Fisher pers. comm. 2018).

Ranaviruses

Ranaviruses are another emerging group of pathogens affecting amphibian populations worldwide. Ranavirus is one of five genera in the family Iridoviridae, a family of viruses known to infect a diversity of invertebrate and ectothermic (cold-blooded) vertebrate hosts. Ranaviruses were originally detected in frogs (Granoff *et al*. 1965, pp. 237-255; Rafferty 1965, pp. 11-17) but are now known to infect and cause disease in fish, reptiles, and other amphibians (Marschang and Miller 2012, p. 1). Ranaviruses are often virulent and can cause systemic infections in amphibians (Daszak *et al*. 1999, p. 742). Mortality caused by ranaviruses has been reported from five continents and in most of the major families of frogs and salamanders (Gray *et al*. 2009, pp. 243-244).

Amphibian larvae seem to be the developmental stage most susceptible to ranaviruses (Daszak *et al*. 1999, p. 742), with physical characteristics of infections in larval stages including skin hemorrhages, ulcers, and bloating (Marschang and Miller 2012, p. 1). Overt signs of infection may not be exhibited in juvenile and adult stages (Daszak *et al*. 1999, p. 742), but when present typically include skin abnormalities (e.g., sloughing, hemorrhaging) and sometimes necrosis (tissue death) of digits and limbs (Cunningham *et al*. 1996, pp. 1539, 1541; Jancovich *et al*. 1997, p. 163). The exact mechanism by which Ranavirus infections cause amphibian mortalities remains unclear, but hemorrhaging in skeletal tissue (Daszak *et al*. 1999, p. 743) and extensive necrosis in the liver, spleen, kidneys, and digestive tract have been observed in infected individuals (Gray *et al*. 2009, p. 253). It is also postulated that viral infections may suppress the immune system, resulting in secondary invasion by opportunistic pathogens (Miller *et al*. 2008, p. 448).

Sutton *et al*. (2015, entire) sampled fourteen species of Plethodontid salamanders (none from genus *Batrachoseps*) from Great Smoky Mountains National Park and tested the individuals for Ranavirus. Of the total 566 salamanders that were sampled, 103 were positive for Ranavirus, across 11 of the 14 species (Sutton *et al*. 2015, p. 324). Ranavirus outbreaks among lesser slender salamanders have not been documented.

8.4 Summary -- Current Condition

The lesser slender salamander is currently known to be present in seven of eight occurrence locations; presumably the species' current range is the same as its historic range. Current population abundance for the lesser slender salamander at each occurrence is unknown. The two threats that could be have the greatest impact on populations or rangewide are: (1) changing climate conditions, and (2) disease.

Current effects to the lesser slender salamander from increased temperatures due to climate change include, but are not limited to: reduction of cool, moist areas that supply habitat and reduced survival of all life stages. During the daytime, plethodontid salamanders inhabit moist places under rocks, bark, logs, within rotten wood, and in animal burrows, and they emerge at night when conditions are suitable. Slender salamanders use damp locations under logs, bark, and rocks, in leaf litter and termite galleries, and in crevices of rocks, logs, and stumps, suggesting that they may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. The species may continue

to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a current population-level effect.

As for disease, Bd has been found in lesser slender salamanders, however the vulnerability of lesser slender salamanders to Bd infection and developing chytridiomycosis is unknown. Two congeners have differing susceptibility. In *B. attenuatus*, there is some level of susceptibility to infection, however it appears that Bd prevalence has been decreasing over time in this species. In contrast, *B. luciae* appears to be highly susceptible to Bd infection. While the lesser slender salamander has been shown to be susceptible to Bd there are no data to suggest current die-offs, and individual lesser slender salamanders may have the potential to shed the infection as habitat conditions become drier over the summer months, which would decrease the prevalence of disease in the population.

At this time, climate effects and disease are potential threats that could affect all salamander species. Currently the best available data indicates that climate change and disease will affect *B. minor* on an individual level. We do not anticipate that climate effects or disease are population-level threats to the species because *B. minor* is flexible in behavior and can find suitable habitat when faced with the effects of climate change and the prevalence of disease may be reduced due to drier conditions.

All of the previously discussed threats may act on the lesser slender salamander in combination and we evaluated all of these threats combined to examine the total effect on the species. In particular, threats such as habitat loss, road mortality, climate change and disease may act on the lesser slender salamander in combination to affect the species. Some minor habitat loss may occur along with random road mortalities and continued climate change effects with occasional disease could occur together to affect the lesser slender salamander. Yet, even cumulatively, there is little suggest that anything more than a few individuals are being currently affected. We evaluated the combined effects of pesticide drift, overutilization, collection or predation and we found no information to indicate that they are a concern for the lesser slender salamander under current conditions. The totality of effects from all of the identified threats is likely to affect the lesser slender salamander on the individual scale, but we do not anticipate that these combined effects are having negative impacts at the population- or on the species-wide scale.

8.5 Summary Current Condition – Resiliency, Representation, and Redundancy

We do not have data to determine the resiliency of lesser slender salamander populations. Resiliency is positively related to population size and growth rate and may be influenced by connectivity among populations. We would need information on abundance, growth rate, or an acceptable proxy to determine resiliency and currently no data are available to us. At this time, the best available information indicates that the species is extant at all eight occurrence locations. These occurrence locations encompass the north-south and east-west gradients within its limited distribution, presumably maintaining the relevant adaptive capacity for the species that comprises representation. While redundancy will always be very limited for local, endemic species with a naturally limited range, we believe the lesser slender salamander would be able to withstand a catastrophic event because having 7 or 8 populations likely provides them with enough redundancy to recover from such a loss. Also, it is likely that further populations will be

discovered within the known range due to increased access to private lands. A new site was discovered in December 2018, and is awaiting genetic confirmation as *B. minor*.

9.0 POTENTIAL FUTURE CONDITIONS

We use 25 years as our future timeframe as it encompasses 1-2 regular drought cycles in California and encompasses projections for climate change. We forecast the status of the lesser slender salamander after 25 years under two plausible future scenarios, one with continued climate-related effects and disease at the current level, and a second with continued climate-related effects and increased disease susceptibility.

9.1 Changes in Climate Conditions

Changes in climate have been observed in recent years and are predicted to continue in California (Frankson *et al*. 2017, p. 1). This can include extreme events such as multi-year droughts or heavy rain events (Frankson *et al*. 2017, pp. 2–5). Pierce *et al*. (2013, entire) estimated future changes in temperature and precipitation patterns in California by the 2060s and determined that historically maximum July temperatures are likely to increase and heat waves may span longer durations. Summer temperatures are anticipated to increase along the central coast of California (Pierce *et al*. 2013, p. 843 figure 2b), which could lead to increased evapotranspiration (Diffenbaugh *et al*. 2015, p. 3994). Droughts associated with increased warming in California are anticipated to increase (Diffenbaugh *et al*. 2015, p. 3934; Williams *et al*. 2015, p. 6826; Cook *et al*. 2015, p. 6). Additionally, Cvijanovic *et al*. (2017, p. 8) identified that as the Artic sea-ice cover decreases, precipitation amounts in California decrease, resulting in the potential increase in future droughts in California. Dettinger (2011, pp. 521-522) determined that in the future, extreme storm events may increase in severity beyond historic levels of intensity with potential to increase flood risks and to increase the potential for flooding to occur before and after the primary historical flood season in California.

He *et al*. (2018, p. 4) evaluated historical and projected precipitation and maximum and minimum temperature data, and developed projections for 2020–2099 based on climate model simulations for hydrologic basins of California. The study used two 40-year future periods, mid-century (2020–2059) and late-century (2060–2099), which was compared to a historical (baseline) period of 1951–1990 (He *et al*. 2018, p. 6). All projections on mean annual maximum temperature and minimum temperature showed significant increasing trends. However, no significant trends were detected in historical annual and wet season precipitation for any study regions (He *et al*. 2018, p. 14-15). When looking at drought projections, there was no consensus among projections; however, the majority of projections show a decreasing tendency for severe droughts due to increase in annual precipitation (He *et al*. 2018, p. 17). While there were no significant trends in precipitation for any study regions, most regions are also expected to see an increase in annual precipitation, with the Central Coast region experiencing a +6.4% under RCP 4.5 scenario by mid-century, and an increase of +6.2% by late-century (He *et al*. 2018, pp. 8–9; Figure 4a, 4c).

Overall, projections of climate change along the central coast of California indicate that temperature will increase over the next 25 years. Patterns of precipitation in the future are less

clear; however, when storms do occur, they will likely be more severe than historical/baseline conditions.

9.2 Disease

Bd has been confirmed in the lesser slender salamander but the specific effects of Bd infection in wild individuals and how this might change in the next 25 years is unknown. Some amphibian species appear to be tolerant of infection from Bd, while others experience extirpation (Louca *et al*. 2014, entire). Padgett-Flohr and Hopkins (2009, entire) evaluated museum specimens and found that Bd has been in central California since at least 1961, suggesting Bd is now endemic throughout most of central California, (Padgett-Flohr and Hopkins 2009, p. 8).

Xie *et al*. (2016) projected how climate may influence Bd distribution globally into the future (Xie *et al*. 2016, entire). They found that Bd ranges will shift into higher latitudes and altitudes (Xie *et al*. 2016, p. 14) but did not project future virulence in areas where Bd already occurs. Changes in climate could create situations (e.g., microclimate suitable for the pathogen, shifting species distributions) that shift the pattern for Bd, which could increase or decrease disease risk for the lesser slender salamander and other amphibians (e.g., Adams *et al*. 2017, entire).

For Bsal, Richgels *et al*. (2016, entire) predict that the Pacific coast, southern Appalachian Mountains and mid-Atlantic regions will have the highest relative risk from Bsal, if it were to get into the United States. Given the high risk of Bsal invasion, the Service recently listed 20 amphibian genera known to carry Bsal as injurious under the Lacey Act to limit importation into the United States (USFWS 2016, entire). Given this, we do not anticipate that Bsal is likely cause population-level declines in the lesser slender salamander in the next 25 years.

9.3 Cumulative Effects

All of the previously discussed threats may act on the lesser slender salamander in combination and we evaluated all of these threats combined to examine the total effect on the species. In particular, threats such as habitat loss, road mortality, climate change and disease may act on the lesser slender salamander in combination to affect the species. Some minor habitat loss may occur along with random road mortalities and continued climate change effects with occasional disease could occur together to affect the lesser slender salamander. Yet, even cumulatively, there is little suggest that anything more than a few individuals are being currently affected. We evaluated the combined effects of pesticide drift, overutilization, collection or predation and we found no information to indicate that they are a concern for the lesser slender salamander in the future. The totality of effects from all of the identified threats is likely to affect the lesser slender salamander on the individual scale, but we do not anticipate that these combined effects are having negative impacts at the population- or on the species-wide scale.

9.4 Future Scenario 1: Climate and Disease Continuation

Under Future Scenario 1 (Climate and Disease Continuation), we evaluated the status of the lesser slender salamander after 25 years with continued climate-related effects and disease at the current level. Projections of climate change along the central coast of California indicate that

temperature will increase over the next 25 years. Patterns of precipitation in the future are less clear.

Current effects to the lesser slender salamander from increased temperatures due to climate change include, but are not limited to: reduction of cool, moist areas that supply habitat and reduced survival of all life stages. During the daytime, plethodontid salamanders inhabit moist places under rocks, bark, logs, within rotten wood, and in animal burrows, and they emerge at night when conditions are suitable. Slender salamanders use damp locations under logs, bark, and rocks, in leaf litter and termite galleries, and in crevices of rocks, logs, and stumps, suggesting that they may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. The species may continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a current population-level effect.

As for disease, Bd has been found in lesser slender salamanders, however the vulnerability of lesser slender salamanders to Bd infection and developing chytridiomycosis is unknown. Two congeners have differing susceptibility. In *B. attenuatus*, there is some level of susceptibility to infection, however it appears that Bd prevalence has been decreasing over time in this species. In contrast, *B. luciae* appears to be highly susceptible to Bd infection in the wild. While the lesser slender salamander has been shown to be susceptible to Bd there are no data to suggest current die-offs. In this scenario, we assume that the lesser slender salamander is able to stave off a large-scale disease event due to similarity in disease susceptibility and trends to *B. attenuatus*. Given that currently we do not anticipate that disease is population-level threats to the lesser slender salamander, at this continued level and with similarity in disease susceptibility and trends to *B. attenuates,* we do not anticipate a population-level effect in the next 25 years.

9.5 Future Scenario 2: Climate Continuation and Increased Disease

Under Future Scenario 2 (Climate Continuation and Increased Disease), we evaluated the status of the lesser slender salamander after 25 years with continued climate-related effects and increased disease susceptibility. The climate portion of this scenario is the same as in Scenario 1 and therefore we anticipate that if current trends in climate continue, the species may be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a population-level effect in the next 25 years.

As for potential increase in disease, under this scenario we assume greater susceptibility to existing pathogens. Specifically, Bd has been found in lesser slender salamanders, however the vulnerability of lesser slender salamanders to Bd infection and developing chytridiomycosis is unknown. It is possible that the lesser slender salamander has similar susceptibility to *B. luciae*, which appears to be highly susceptible to wild Bd infection. The USGS tested eight individual lesser slender salamanders collected in 2017 for Bd and found that 2 of the 3 sampled occurrence locations were positive for Bd. Specifically, of the three occurrence locations from which samples were taken, all samples from two of the occurrences (Toro Creek and Santa Rita Creek) were Bd positive, while those from Trout Creek were negative for Bd (R. Fisher pers. comm. 2018).

Given that (1) Bd is currently found in 2 populations, (2) Bd appears to have been in California since the 1960s, peaked in the 1990s, and decreased since then, and (3) the effects of chytridiomycosis can even vary between populations of the same species (Bradley *et al*. 2015, entire), we predict that in the next 25 years, 2 of the 8 occurrence locations will have an associated mass die off and population declines due to Bd under the assumption that the lesser slender salamander has similar susceptibility to *B. luciae*,. The extent of the population declines will be dependent on the variation in infection rate and whether there are resistant individuals who are selected for during such a disease event. Disease at a population-level within 2 of the 8 occurrence locations in the next 25 years would decrease the resiliency of those infected lesser slender salamander occurrence locations. If occurrence locations were extirpated due disease, this would decrease the species already limited distribution.

9.6 Summary of Future Threats

We assessed likely change in climate effects and disease 25 years into the future. Projections of climate change along the central coast of California indicate that temperature will increase in the next 25 years. Current effects to the lesser slender salamander from increased temperatures due to climate change include, but are not limited to: reduction of cool areas that supply habitat and reduced survival of all life stages. The species may continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a current population-level effect.

Potential future effects from disease to the lesser slender salamander are unknown. We know that lesser slender salamanders have tested positive for Bd, but we do not know the species' vulnerability to Bd infection and developing chytridiomycosis. Bd appears to have been in California since the 1960s, peaked in the 1990s, and decreased since then. The effects of chytridiomycosis can vary between populations of the same species (Bradley *et al*. 2015). The prevalence of Bd (i.e., number of positives/number sampled) in different populations is likely reflecting the interaction between the host, the pathogen strain, and the environmental conditions they encounter (Spitzen-Van der Sluijs *et al*. 2014; Bacigalupe *et al*. 2017). We forecast the status of the lesser slender salamander after 25 years under two future scenarios, one with continued climate-related effects and disease at the current level, and a second with continued climate-related effects and increased disease susceptibility.

Under Scenario 1 (Climate and Disease Continuation), we found that lesser slender salamanders may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. If current trends in climate continue, the species may continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a population-level effect in the next 25 years. As for potential disease, we determined that the lesser slender salamander may able to stave off a large-scale disease event due to assumed similarity in disease susceptibility to *B. attenuatus*. Given that currently we do not anticipate that disease is a population-level threat to the lesser slender salamander, at this continued level with susceptibility similar to *B. attenuates,* we do not anticipate a population-level effect in the next 25 years.

Under Scenario 2 (Climate Continuation and Increased Disease), the climate portion is the same as in Scenario 1 and therefore we anticipate that if current trends in climate continue, we do not anticipate a population-level effect in the next 25 years. As for potential increase disease, under this scenario we assume greater susceptibility to Bd. It is possible that the lesser slender salamander has similar susceptibility to *B. luciae*, which appears to be highly susceptible to wild Bd infection. Based on the USGS findings that 2 of the occurrence locations tested positive for Bd, we assume that approximately 2 of the 8 occurrence locations will have an associated mass die off and population declines due to Bd in the next 25 years. This could decrease the resiliency of those 2 lesser slender salamander occurrence locations. The resiliency of the rest of the occurrence locations would not be affected. If there were extirpations, species representation and redundancy could be reduced.

In summary, both of the two future scenarios do not anticipate a population-level effect from changing climate in the next 25 years. Our first future scenario does not anticipate that disease is population-level threat to the lesser slender salamander in the next 25 years; whereas the second future scenario suggests that disease could be a population-level threat to the species, but would not occur rangewide.

10.0 OVERALL SYNTHESIS

Resiliency, Redundancy, and Representation

At this time, we do not have any data to determine the resiliency of lesser slender salamander populations. However, the best available information indicates that the species is extant at 7 of 8 occurrences*. These occurrences encompass the north-south and east-west gradients within its limited distribution, maintaining species representation. While redundancy will always be limited for species with limited range, it appears that the redundancy of the lesser salamander is sufficient. * the new locality is close to the Cuesta Ridge site

In the future, we assessed the status of the lesser slender salamander under two scenario 25 years into the future. The first future scenario does not anticipate a population-level effect from changing climate or disease in the next 25 years, suggesting that occurrence location resiliency and species representation and redundancy would remain unchanged. Our second future scenario does not anticipate a population-level effect from changing climate but does anticipate that disease could be a population-level threat to the species, but would not occur rangewide. Where disease occurs the resiliency of those populations would be reduced. If populations were able to recover from declines and no extirpations occurred, species representation and redundancy may remain unchanged. If extirpations occurred, species representation and redundancy could be reduced.

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APPENDIX I. Existing Regulatory Mechanisms

Eight occurrences of the lesser slender salamander have been found at locations along the Santa Lucia Range in San Luis Obispo County, California. From north to south the occurrence locations are referred to as: (1) Las Tablas Ridge, (2) Black Mountain, (3) York Mountain, (4) Santa Rita Creek, (5) Toro Creek, (6) Cerro Alto, (7) Cuesta Ridge, and (8) Trout Creek (S. Sweet pers. comm. 2017.). We define "occurrences locations" as the locality where lesser slender salamanders have been found. Two of the 8 occurrence locations are on U.S. Forest Service Lands (Cerro Alto and Cuesta Ridge: Los Padres National Forest, Santa Lucia Ranger District); the other 6 occurrence locations are on private land, of which, 2 are within the Los Padres National Forest boundary (Toro Creek and Trout Creek).

Federal Mechanisms

All Federal agencies are required to adhere to the National Environmental Policy Act (NEPA) of 1970 (42 U.S.C. 4321 et seq.) for projects they fund, authorize, or carry out. Prior to implementation of such projects with a Federal nexus, the NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural resources. The Council on Environmental Quality's regulations for implementing the NEPA states that agencies shall include a discussion on the environmental impacts of the various project alternatives (including the proposed action), any adverse environmental effects that cannot be avoided, and any irreversible or irretrievable commitments of resources involved (40 CFR part 1502). The public notice provisions of the NEPA provide an opportunity for the Service and other interested parties to review proposed actions and provide recommendations to the implementing agency. The NEPA does not impose substantive environmental obligations on Federal agencies—it merely prohibits an uninformed agency action. However, if an Environmental Impact Statement is prepared for an agency action, the agency must take a "hard look" at the consequences of this action and must consider all potentially significant environmental impacts. Federal agencies may include mitigation measures in the final Environmental Impact Statement as a result of the NEPA process that may help to conserve the Panamint alligator lizard or its habitat.

The Organic Act of 1897 (16 U.S.C. 475–482) established general guidelines for administration of timber on U.S. Forest Service (USFS) lands, which was followed by the Multiple-Use Sustained- Yield Act (MUSY) of 1960 (16 U.S.C. 528–531), which broadened the management of USFS lands to include outdoor recreation, range, watershed, and wildlife and fish purposes.

The National Forest Management Act (NFMA) of 1976 (16 U.S.C. § 1600 et seq.) requires the USFS to develop a planning rule under the principles of the MUSY of 1960 (16 U.S.C. 528–531). The NFMA outlines the process for the development and revision of the land management plans and their guidelines and standards [16 U.S.C. 1604(g)]. A new National Forest System (NFS) land management planning rule (Planning Rule) was adopted by the USFS in 2012 (77 FR 21162; April 9, 2012). The new Planning Rule guides the development, amendment, and revision of land management plans for all units of the NFS to maintain and restore NFS land and water ecosystems while providing for ecosystem services and multiple uses. Land management plans (also called Forest Plans) are designed to: (1) Provide for the sustainability of ecosystems and resources; (2) meet the need for forest restoration and conservation, watershed protection, and

species diversity and conservation; and (3) assist the USFS in providing a sustainable flow of benefits, services, and uses of NFS lands that provide jobs and contribute to the economic and social sustainability of communities (77 FR 21261, April 9, 2012). A land management plan does not authorize projects or activities, but projects and activities must be consistent with the plan (77 FR 21261; April 9, 2012). The plan must provide for the diversity of plant and animal communities, including species-specific plan components in which a determination is made as to whether the plan provides the "ecological conditions necessary to . . . contribute to the recovery of federally listed threatened and endangered species . . ." (77 FR 21265; April 9, 2012).

The Record of Decision for the final Planning Rule was based on the analyses presented in the Final Programmatic Environmental Impact Statement, National Forest System Land Management Planning (77 FR 21162–21276; April 9, 2012), which was prepared in accordance with the requirements of the NEPA. In addition, the NFMA requires land management plans to be developed in accordance with the procedural requirements of the NEPA, with a similar effect as zoning requirements or regulations as these plans control activities on the national forests and are judicially enforceable until properly revised (Wilkinson and Anderson 2002, entire).

Two of the 8 occurrence locations are on U.S. Forest Service Lands (Los Padres National Forest, Santa Lucia Ranger District) and 2 others occurrences are within the Los Padres National Forest boundary. There is no Forest Service management plan in place for the Los Padres that includes amphibian management. There is a forest-wide management plan that outlines general approaches to forest management, and management plans are developed on a project-by-project basis (Cooper pers. comm. 2018).

State Mechanisms

The lesser slender salamander is designated as a California Department of Fish and Wildlife Species of Special Concern (California Department of Fish and Wildlife Natural Diversity Database, 2018). It is the goal and responsibility of the California Department of Fish and Wildlife to maintain viable populations of all native species. To this end, the Department has designated certain vertebrate species as Species of Special Concern because declining population levels, limited ranges, and/or continuing threats have made them vulnerable to extinction. The goal of designating species as "Species of Special Concern" is to halt or reverse their decline by calling attention to their plight and addressing the issues of concern early enough to secure their long term viability. Not all "Species of Special Concern" have declined equally; some species may be just starting to decline, while others may have already reached the point where they meet the criteria for listing as a "Threatened" or "Endangered" species under the State Endangered Species Act. The lesser slender salamander is not listed under the State Endangered Species Act.

California SSCs should be considered during the environmental review process under the California Environmental Quality Act (CEQA; California Public Resources Code §§ 21000-21177). Similar to the Federal NEPA, the CEQA requires State agencies, local governments, and special districts to evaluate and disclose impacts from "projects" in the State. Section 15380 of the CEQA Guidelines indicates that California SSCs should be included in an analysis of project impacts if they can be shown to meet the criteria of sensitivity outlined therein.

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Cooper, K. 2018. Phone call from Eric Morrissette to Kevin Cooper, U.S. Forest Service, Los Padres National Forest, Santa Lucia Ranger District. October 25, 2018.

From: Russell, Daniel
To: Deborah Giglio; Cat Darst; Eric Morrissette
Subject: Fwd: [EXTERNAL] Re: Request for Peer Review - Lesser Slender Salamander
Date: Monday, January 28, 2019 8:16:15 AM

FYI...in case I hadn't already forwarded to you all.

****
Daniel Russell - Regional Listing Coordinator
Pacific Southwest Regional Office, Region 8
U.S. Fish and Wildlife Service
2800 Cottage Way, Room W-2606
Sacramento, CA 95825
Office (916) 978-6191
Cell (916) 335-9060
****

---------- Forwarded message ---------
From: **Richard Highton** <rhighto1@umd.edu>
Date: Sun, Dec 23, 2018 at 8:53 AM
Subject: [EXTERNAL] Re: Request for Peer Review - Lesser Slender Salamander
To: Russell, Daniel <daniel_russell@fws.gov>

Dear Mr. Russell.

I am sorry to say that I am not an expert on the Lesser Slender Salamander and don't know much of anything about it. I did suggest a revision of the taxonomy of Batrachoseps attenuatus, but that was not based on field experience in California, but on papers by people in California (Jockusch and Wake) that have studied it. I'm sure you are also contacting them..

Cordially,
Richard Highton

On Thu, Dec 20, 2018 at 3:52 PM Russell, Daniel <daniel_russell@fws.gov> wrote:

> Dear Dr. Highton:
>
> The U.S. Fish and Wildlife Service (Service) is soliciting independent scientific reviews of the information contained in our 2018 draft Species Status Assessment Report for the Lesser Slender Salamander (*Batrachoseps minor*). Once finalized, this Species Status Assessment report (SSA report) will provide the underlying science on which we will base our decision on whether the species warrants listing as endangered or threatened under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.). You were identified by our Ventura Fish and Wildlife Office as a potential peer reviewer based on your area of expertise.
>
> This request is provided in accordance with our July 1, 1994, peer review policy (USFWS 1994, p. 34270) and our current internal guidance. This request also satisfies the peer review requirements of the Office of Management and Budget's "Final Information Quality Bulletin for Peer Review." The purpose of seeking independent peer review of the SSA is to ensure use of the best scientific and commercial information available; to ensure and maximize the quality, objectivity, utility, and integrity of the information upon which we base listing and recovery actions; and to ensure that reviews by recognized experts are incorporated into our final rulemaking processes. Please let us know if you would like us to provide any of the referenced materials to help facilitate your review.
>
> Please note that we are not seeking advice on policy or recommendations on the legal status of

the species. Rather, we request that peer reviewers focus their review on identifying and characterizing scientific uncertainties, and on ensuring the accuracy of the biological and land and water use information in the SSA. Specifically, we ask peer reviewers to focus their comments on the following:

(1) Have we assembled and considered the best available scientific and commercial information relevant to this species?

(2) Is our analysis of this information correct?

(3) Are our scientific conclusions reasonable in light of this information?

Our updated peer review guidelines also require that all peer reviewers fill out a conflict of interest form. We will carefully assess any potential conflict of interest or bias using applicable standards issued by the Office of Government Ethics and the prevailing practices of the National Academy of Sciences (http://www.nationalacademies.org/coi/index.html). Divulging a conflict does not invalidate the comments of the reviewer; however, it will allow for transparency to the public regarding the reviewer's possible biases or associations. If we receive comments from a reviewer that we deem to have a substantial conflict of interest, we will evaluate the comments in light of those conflicts, and may choose not to give weight to those comments if the conflict is viewed as problematic. You may return the completed conflict of interest form either prior to or with your peer review.

So that we may fully consider any input and coordinate other peer review comments as we develop the final SSA, and ensure adequate time to complete our 12-month finding, we are requesting peer review comments by January 10, 2019. If you are willing to peer review but are unable to complete your assessment during this time period, please let me know when we may anticipate receiving your comments. We will summarize and respond to the substantive comments raised by all peer reviewers and use the information, as appropriate, in the final SSA.

While we welcome your peer review comments in any format you are most comfortable using, it would be especially helpful if you could use the attached Comment Matrix Excel spreadsheet. This will make it easier to compile and keep a record of all the comments received and then incorporate them into our report. We would also appreciate receiving a copy of your Curriculum Vitae for our records. Please be aware that your completed review of the SSA, including your name and affiliation, will be included in the administrative record for this evaluation and will be available to interested parties upon request.

If you have any questions about the draft SSA report, or our listing policies in general, please feel free to contact me at any time at (916) 978-6191. Please submit your comments and associated materials to the contact information below, and you may also include the cc: list to this email in your reply.

Thank you very much for your consideration.

Sincerely,
Dan Russell

****

Daniel Russell - Regional Listing Coordinator
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From: Russell, Daniel
To: Deborah Giglio; Cat Darst; Eric Morrissette
Subject: Fwd: [EXTERNAL] Re: Request for Peer Review - Lesser Slender Salamander
Date: Monday, January 28, 2019 8:13:35 AM
Attachments: ATT00001.htm
20181220_Draft_LSS_SSA_CLEAN for PeerReview_EJcomments.docx
20181220_Draft_LSS_SSA_CLEAN for PeerReview_EJcomments.pdf
ATT00002.htm
AdditionalReferences_BminorReview.rtf
ATT00003.htm
Bminor_PopulationStatusSummary.pptx
ATT00004.htm
Jockusch_Bminor_SSA Review Comment Matrix.xlsx
ATT00005.htm
Bminor_JockuschDraftStatusReportCoverLetter.pdf
ATT00006.htm
Jockusch_Conflict of Interest Disclosure Form_Jan2019.pdf
ATT00007.htm

FYI

****

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---------- Forwarded message ---------
From: **Elizabeth Jockusch** <elizabeth.jockusch@uconn.edu>
Date: Wed, Jan 9, 2019 at 1:11 PM
Subject: [EXTERNAL] Re: Request for Peer Review - Lesser Slender Salamander
To: Russell, Daniel <daniel_russell@fws.gov>

Dear Dan,
Attached please find my comments on the draft report, along with some supporting documents and the signed conflict of interest report. I'm happy to help as best I can in any additional capacity that assists in your evaluation of this species.
Sincerely,
Elizabeth

Elizabeth Jockusch
Professor, Ecology and Evolutionary Biology
University of Connecticut
860-486-4452

UCONN
UNIVERSITY OF CONNECTICUT

8 January, 2019

To whom it may concern,

At the request of the U. S. Fish and Wildlife Service, I have carefully reviewed the 2018 draft Species Status Assessment Report for the Lesser Slender Salamander (*Batrachoseps minor*) with respect to the following three questions:

(1) Have we assembled and considered the best available scientific and commercial information relevant to this species?

(2) Is our analysis of this information correct?

(3) Are our scientific conclusions reasonable in light of this information?

My specific comments are attached; the full set of comments is entered using the comments function within MS Word. I also added line numbers to the Word document, converted to pdf to ensure they don't change, and included my main comments on the excel comment sheet as well. Additionally, I have provided a 1 page figure that highlights my understanding of the current status of each locality and reference information for a few additional sources that I cite.

Overall, I believe that the report is comprehensive and carefully considered. Below I highlight three points that I make in my review that I believe are worth taking into consideration before finalizing the report.

B. minor is known from 9 distinct localities. I think the 8 listed here may reflect treating the Atascadero Creek locality and the Cerro Alto locality as a single locality. However, these are in different watersheds, and nearly as far apart from each other as they are from the newly discovered Toro Creek locality, so I believe that it is more accurate to treat them as separate localities.

The report indicates that *B. minor* has been seen at all known localities since 2011, and thus that the best available evidence indicates that the species is extant at all localities. However, I think that the claim that individuals have been seen at all known localities since 2011 is most likely based on a misunderstanding. To my knowledge (including close contact with Sam Sweet about the status of this species), no specimens have been seen at 3 historic localities (Black Mountain, Atascadero, Cuesta Ridge) since the 1970s. Additionally, the Cerro Alto locality, is known from a single specimen discovered in 2008. To my knowledge, no additional specimens have been seen. Of course, none of this is sufficient to conclude that the species does not exist at any of these localities, but I believe that in light of this, the evidence supports a bit more cautious interpretation of the probability of population persistence at these localities than the current draft report provides in places.

Finally, the only statements about abundance concern a lack of knowledge about abundance. At one level, this is true and frustrating—to my knowledge, there are no systematic data or surveys that are designed as quantitative surveys. However, the collecting records (e.g., comparisons of specimen numbers in the Museum of Vertebrate Zoology, or of specimens of *B. nigriventris* vs. *B. minor* seen by Sam Sweet or others when revisiting these localities) suggests that two statements about relative abundance are supported by the current evidence:

The abundance of *B. minor* has declined to a much greater extent since the 1970s than has the abundance of sympatric *B. nigriventris* at at least some of the historic localities.

The abundance of *B. minor* at several of its localities (for sure Cerro Alto and Cuesta Ridge, at each of which only a single individual has been found) is low (and lower than at some other localities, including for sure Santa Rita Creek, Trout Creek, and York Mountain).

Of course, I'm happy to answer any questions you may have about my comments, and to provide any additional input that you would find helpful.

Sincerely,

Elizabeth L. Jockusch

Elizabeth L. Jockusch, Professor
Ecology and Evolutionary Biology
University of Connecticut

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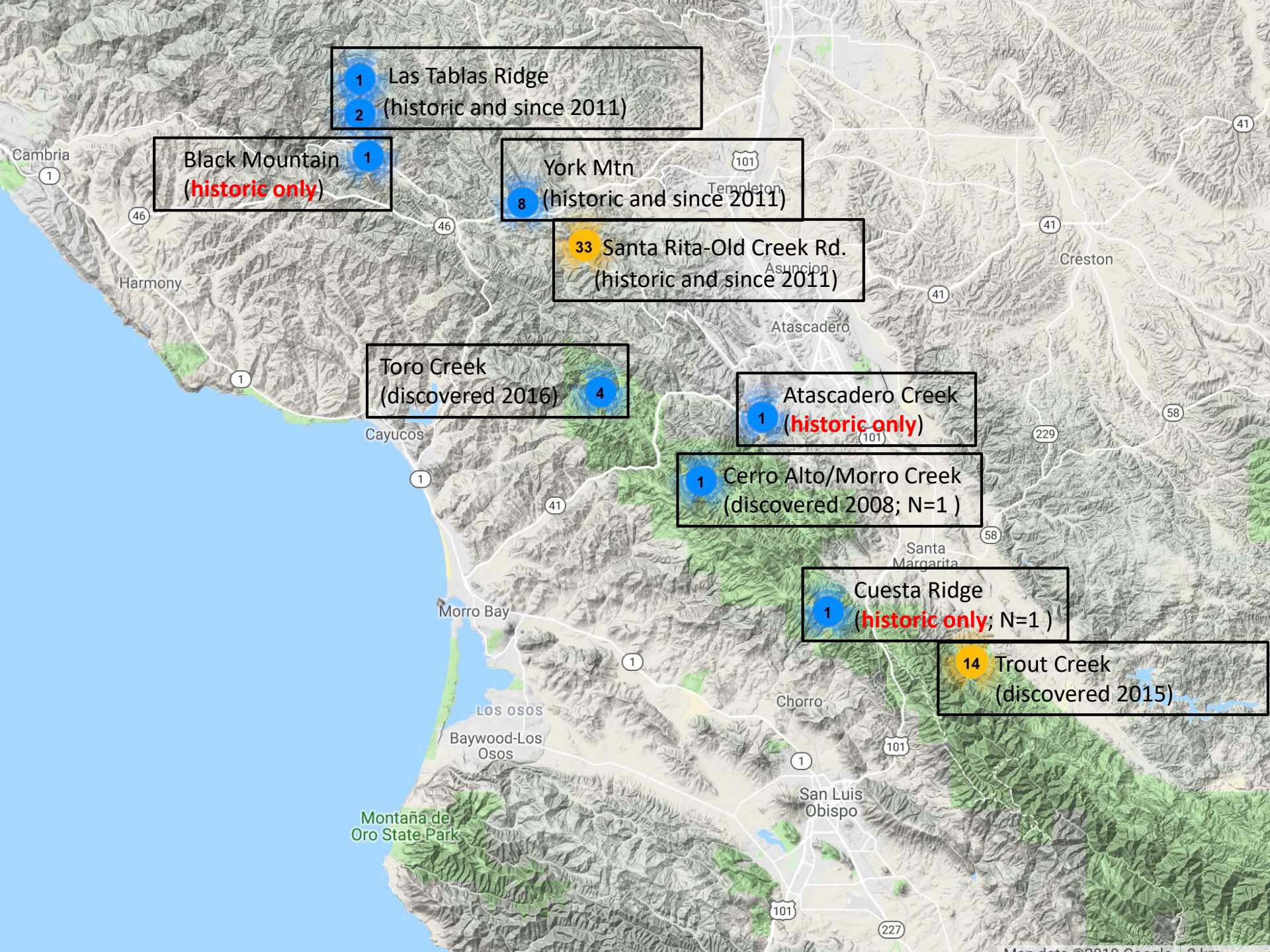
1 Las Tablas Ridge
2 (historic and since 2011)
Black Mountain
1
(historic only)
York Mtn
8 (historic and since 2011)
33 Santa Rita-Old Creek Rd.
(historic and since 2011)
Toro Creek
(discovered 2016)
4
Atascadero Creek
1 (historic only)
1 Cerro Alto/Morro Creek
(discovered 2008; N=1)
Cuesta Ridge
1 (historic only; N=1)
14 Trout Creek
(discovered 2015)
Cambria
Harmony
Templeton
Asuncion
Creston
Atascadero
Cayucos
Santa Margarita
Morro Bay
LOS OSOS
Baywood-Los Osos
Chorro
San Luis Obispo
Montaña de Oro State Park

Draft

Lesser Slender Salamander (*Batrachoseps minor*) Species Status Assessment

An adult Lesser Slender Salamander from coastal south central California. Photo credit: Kenneth Wray

December 2018

ACKNOWLEDGEMENTS

Core Team:

Eric Morrissette, U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office, Ventura, CA
Catherine Darst, U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office, Ventura, CA
Deborah Giglio, U.S. Fish and Wildlife Service, Pacific Southwest Regional Office, Sacramento, CA

Peer Reviewers:

TBD

Partner Reviewers:

TBD

SUGGESTED LITERATURE CITATION OF THIS DOCUMENT:

U.S. Fish and Wildlife Service. 2018. Species Status Assessment Report for the lesser slender salamander (*Batrachoceps minor)*. U.S. Fish and Wildlife Service, Pacific Southwest Region, Ventura, California.

EXECUTIVE SUMMARY

On July 11, 2012, we, the U.S. Fish and Wildlife Service (Service), received a petition from the Center for Biological Diversity requesting that 53 species of reptiles and amphibians, including the lesser slender salamander (*Batrachoseps minor*), be listed as endangered or threatened and that critical habitat be designated for these species under the Endangered Species Act. The petition states that lesser slender salamanders have become rare, and raises habitat loss, road mortality, climate change, and pesticide drift as potential threats to the species. On September 18, 2015, we published a 90-day finding that the petition presented substantial scientific or commercial information indicating that the petitioned action may be warranted (80 CFR 56427-56428). In September 2016, we published a 7-Year National Listing Workplan (https://www.fws.gov/endangered/what-we-do/listing-workplan.html), which called for completion of the status review for the lesser slender salamander by the end of September, 2019. In this Species Status Assessment, we evaluate the biological status of the lesser slender salamander, both currently and into the future, by considering the species' resiliency, redundancy, and representation. The scientific information presented here is for the purpose of informing our 12-month finding.

In 2001, the lesser slender salamander was described as a unique species based primarily on genetics, and also morphology. The lesser slender salamander is one of 21 species in the genus *Batrachoseps* (slender salamanders) in the Family Plethodontidae (lungless salamanders) that occur in California. The lesser slender salamander has the smallest average adult size of all slender salamanders and has a robust body and relatively long legs and tail for its size when compared to other slender salamander species.

The lesser slender salamander has been observed in eight occurrence locations that occur entirely within the Santa Lucia Mountain Range in San Luis Obispo County, California. From north to south the occurrences are referred to as: (1) Las Tablas Ridge, (2) Black Mountain, (3) York Mountain, (4) Santa Rita Creek, (5) Toro Creek, (6) Cerro Alto, (7) Cuesta Ridge, and (8) Trout Creek. Two of the eight occurrence locations are on U.S. Forest Service Lands (Cerro Alto and Cuesta Ridge: Los Padres National Forest, Santa Lucia Ranger District); the other six occurrence locations are on private land. The lesser slender salamander is currently known to be present in all eight occurrence locations. Abundance data for the lesser slender salamander are not well known rangewide or at any of the eight occurrence locations.

Lesser slender salamanders require habitat comprised of terrestrial areas with small interstitial spaces needed to hide from predators and for feeding and that are moist to meet the species' requirements for breeding. A resilient lesser slender salamander population is one that is self-sustaining and has suitable habitat for feeding, breeding, and sheltering. Representation in the lesser slender salamander is the breadth of diversity across historical latitudinal, longitudinal, and elevation gradients, as well as climatic gradients. Lesser slender salamander redundancy contributes to the ability of the species to withstand catastrophic events (e.g., widespread drought, catastrophic wildfire, and flooding) which is related to the number, distribution, and resilience of populations.

elj 1/5/19 9:36 PM
Comment [1]: True that 21 species are recognized, but only 20 occur in CA (not wrighti)

elj 1/6/19 6:37 PM
Comment [2]: nine—details below

elj 1/6/19 7:45 PM
Comment [3]: I believe this reflects a misunderstanding of where animals have and have not been found recently; to my knowledge, at 3 of 9 sites (Black Mountain, Atascadero Creek, Cuesta Ridge), B. minor has not been reported recently. This of course does not mean that they aren't there—access is limited at some of these places. At one of the recently discovered localities (Cerro Alto), only 1 individual has been found, in 2008; repeated surveys at that site since its discovery have not yielded additional individuals of B. minor.

elj 1/6/19 6:39 PM
Comment [4]: Agreed that there's no info. on absolute abundances, but there is some information on relative abundances—so there are a few localities where we can definitely say the animals do NOT appear to be abundant (historically and/or at present) and a few localities where we can definitively say that abundances have decreased, although we cannnot precisely quantify the decrease.

We identified potential threats that could negatively affect lesser slender salamanders and thus pose a risk to resiliency, representation, and redundancy of the species We evaluated habitat loss, pesticide drift, road mortality, changing climate effects, and disease as potential threats to the lesser slender salamander and determined that changing climate and disease are the most likely threats to the species.

Current effects to the lesser slender salamander from increased temperatures due to changing climate include, but are not limited to: reduction of cool, moist areas that supply habitat and reduced survival of all life stages. During the daytime, Plethodontid salamanders inhabit moist places under rocks, bark, logs, within rotten wood, and in animal burrows, and they emerge at night when conditions are suitable. Slender salamanders use damp locations under logs, bark, and rocks, in leaf litter and termite galleries, and in crevices of rocks, logs, and stumps, suggesting that they may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. The species may continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a current population-level effect.

As for disease, *Batrachochytrium dendrobatidis* (Bd) has been found in lesser slender salamanders, however the vulnerability of the species to Bd infection and developing chytridiomycosis is unknown. Two congeners have differing susceptibility. In *B. attenuatus*, there is some level of susceptibility to infection, however it appears that Bd prevalence has been decreasing over time in this species. In contrast, *B. luciae* appears to be highly susceptible to wild Bd infection. While the lesser slender salamander has been shown to be susceptible to Bd, there are no data to suggest current die-offs. The species may continue to be affected by disease on the individual level, but we do not expect a current population-level effect.

At this time, the best available information indicates that the species is extant at all eight occurrence locations. These occurrence locations encompass the north-south and east-west gradients within its limited distribution, maintaining the relevant genetic diversity and associated adaptive capacity for the species that comprise representation. While redundancy will always be very limited for local, endemic species with a naturally limited range, it appears that the redundancy of the lesser salamander is sufficient.

We assessed likely change in climate and disease 25 years into the future. Projections of climate change along the central coast of California indicate that temperature will increase in the next 25 years. As for disease, we know that lesser slender salamanders have tested positive for Bd, but we do not know the species' vulnerability to Bd infection and developing chytridiomycosis. Bd appears to have been in California since the 1960s, peaked in the 1990s, and decreased since then.

We forecast the status of the lesser slender salamander after 25 years under two plausible future scenarios, one with continued climate-related effects and disease at the current level, and a second with continued climate-related effects and increased disease susceptibility. Under Scenario 1 (Climate and Disease Continuation), we found that lesser slender salamanders may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. If current trends in climate continue, the species may

elj 1/6/19 8:53 PM

Comment [5]: In my judgment, this overstates the evidence; I would phrase as best available information indicates that the species is extant at at least 5 of the nine locations. (There is insufficient information about the population status at the other four localities. In two of those places, I and others have looked repeatedly, without finding individuals, suggesting that if they are present, they are very low abundance. Both of these are localities known from only a single individual, so no conclusion can be drawn about whether the population is extant.) At one locality, Atascadero Creek, repeated searches, primarily by Sam Sweet, and also by me, have only yielded B. nigriventris. I have never been to Black Mountain; I believe that Sam Swet has, but I nearly 100% sure that no B. minor have been reported from there since the 1970s.

continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a population-level effect in the next 25 years. As for disease, we determined that there may be decreased disease prevalence in the lesser slender salamander in the future, due to assumed similarity in disease susceptibility to *B. attenuatus*. Given that currently we do not anticipate that disease is population-level threat to the lesser slender salamander, at this continued level with disease susceptibility similar to *B. attenuates,* we do not anticipate a population-level effect in the next 25 years. We do not anticipate combined or synergistic effects of these threats under this scenario to pose population-level risk to the species into the future.

elj 1/6/19 6:42 PM

Comment [6]: If one has to choose whether to predict similarity to B. luciae or B. attenuatus, B. luciae is much more closely related, and thus a better justified choice.

Under Scenario 2 (Climate Continuation and Increased Disease), the climate portion is the same as in Scenario 1 and therefore we anticipate that if current trends in climate continue, we do not anticipate a population-level effect in the next 25 years. As for potential increase in disease, under this scenario we assume greater susceptibility to Bd. It is possible that the lesser slender salamander has similar susceptibility to *B. luciae*, which appears to be highly susceptible to wild Bd infection. Based on the USGS findings that 2 of the occurrence locations tested were positive for Bd, in the next 25 years, we assume that approximately 2 of the 8 occurrence locations will have an associated mass die off and population declines due to Bd. This could decrease the resiliency of those 2 lesser slender salamander occurrence locations. The resiliency of the rest of the occurrence locations would not be affected. If there were extirpations, species representation and redundancy could be reduced.

In summary, under the first future scenario, occurrence location resiliency and species representation and redundancy would likely remain unchanged. Under the second future scenario, disease could act as a population-level threat to the species, but would not occur rangewide.

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1.0 INTRODUCTION

This report is the species status assessment (SSA) for the lesser slender salamander (*Batrachoseps minor*). We, the U.S. Fish and Wildlife Service (Service), developed this SSA for the lesser slender salamander to compile and evaluate the best available scientific information regarding the species' biology and factors that influence the species' viability.

1.1 Petition History

On July 11, 2012, we received a petition from the Center for Biological Diversity requesting that 53 species of reptiles and amphibians, including the lesser slender salamander (*Batrachoseps minor*), be listed as endangered or threatened and that critical habitat be designated for these species under the Endangered Species Act. The petition states that lesser slender salamanders have become rare and raises habitat loss, road mortality, climate change, and pesticide drift as potential threats to the species. On September 18, 2015, we published a 90-day finding that the petition presented substantial scientific or commercial information indicating that the petitioned action may be warranted (80 CFR 56427-56428). In September 2016, we published a 7-Year National Listing Workplan (https://www.fws.gov/endangered/what-we-do/listing-workplan.html), which called for completion of the status review for the lesser slender salamander by the end of September, 2019. In this Species Status Assessment, we evaluate the biological status of the lesser slender salamander, both currently and into the future, by considering the species' resiliency, redundancy, and representation. The scientific information presented here is for the purpose of informing our 12-month finding.

2.0 METHODOLOGY

As described in our guidance document, the SSA Framework (Service 2016a, entire), an SSA Report first begins with a compilation of the best available information on the species (taxonomy, life history, and habitat) and its ecological needs at the individual, population, and/or species levels based on how environmental factors are understood to act on the species and its habitat. Next, an SSA Report describes the current condition of the species' habitat and demographics, and the probable explanations for past and ongoing changes in abundance and distribution within the species' ecological settings (that is, areas representative of geographic, genetic, or life history variation across the range of the species). Lastly, an SSA forecasts the species' response to probable future scenarios of environmental conditions. An SSA uses the conservation biology principles of resiliency, representation, and redundancy (collectively known as the "3Rs", Shaffer and Stein 2000, pp. 308-311) as a lens through which we can evaluate the current and future condition of the species (Smith *et al*. 2018, entire). Ultimately, an SSA characterizes a species' ability to sustain populations in the wild over time based on the best scientific understanding of current and future abundance and distribution within the species' ecological settings.

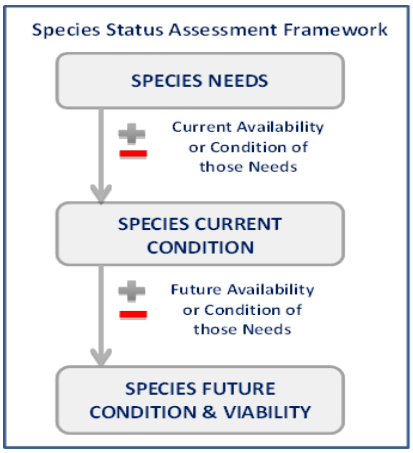


Figure 1. Species Status Assessment Framework

- Resiliency describes the ability of populations to withstand stochastic disturbance. Resiliency is positively related to population size and growth rate and may be influenced by connectivity among populations. Generally speaking, populations need abundant individuals within habitat patches of adequate area and quality to maintain survival and reproduction in spite of disturbance.

- Representation describes the ability of a species to adapt to changing environmental conditions over time. It is characterized by the breadth of genetic and environmental diversity within and among populations. Measures may include the number of varied niches occupied, the gene diversity, heterozygosity or alleles per locus.

- Redundancy describes the ability of a species to withstand catastrophic events. Redundancy is characterized by having multiple, resilient populations distributed within the species' ecological settings and across the species' range. It can be measured by population number, spatial extent, and degree of connectivity.

This document draws scientific information from resources such as primary peer-reviewed literature, reports submitted to the Service and other public agencies, species occurrence information in Geographic Information Systems (GIS) databases, and expert experience and observations. It is preceded by and draws upon analyses presented in other Service documents including the 90-day finding (Service 2015). Finally, we coordinated closely with our partners engaged in ongoing research. This assures consideration of the most current scientific and conservation status information.

3.0 SPECIES BACKGROUND

3.1 Taxonomy

The lesser slender salamander is one of 21 species in the genus *Batrachoseps* (slender salamanders) in the Family Plethodontidae (lungless salamanders) that occur in California (Highton *et al*. 2017, pp. 27-28).

In the early 1950s, there was thought to be one species of slender salamander throughout California; however, by the end of the decade multiple species of slender salamanders were recognized, and in 2001, the lesser slender salamander was described as a distinct species (Jockusch *et al*. 2001, pp. 54, 65-67). Jockusch *et al*. (2001, pp.65-66, 72-81) described morphological and genetic differences between the lesser slender salamander and other slender salamander species; however, slender salamanders are not easily differentiated through morphology alone.

3.2 Species Description

Slender salamanders are small, with bodies that are rounded with costal and caudal grooves similar in appearance to the body segments of earthworms, and with short limbs (Stebbins and McGinnis 2012, p. 124-125). Slender salamanders have four toes on both front and hind feet; all other western salamanders typically have four toes on front and five toes on hind feet (Stebbins 2003, p. 182). Slender salamanders can have a dorsal stripe of reddish, tan, or buff (Stebbins 2003, p. 182).

The lesser slender salamander has the smallest average adult size of all slender salamanders, with a snout-to-vent range of 2.5 to 4.6 cm (1 to 2.3 in.) (Stebbins and McGinnis 2012, p. 137). Although small in size, the species has a robust body and relatively long legs and tail for its size when compared to other slender salamander species (Stebbins and McGinnis 2012, p. 137). Coloring of lesser slender salamanders is dark blackish brown above and a dorsal stripe may or may not be present, which can be tan with pink to apricot highlights especially prominent in the tail (Stebbins 2003, p. 191).

3.3 Genetics

Jockusch *et al*. (2001, entire) analyzed morphology, allozymes, and mitochondrial DNA of individual lesser slender salamanders collected from two locations in San Luis Obispo County, California, and individuals of other species of slender salamanders from other areas within Monterey, San Luis Obispo, Santa Cruz, San Benito, Fresno, and Kern Counties in California. Their analyses resulted in the description of four new slender salamander species that were previously treated as a single species, *B. pacificus*.

The lesser slender salamander resides in the *B. pacificus* species group (Wake and Jockusch 2000, p. 100), which is comprised of six slender salamander species that reside in three geographically disjunct units in coastal California (Jockusch *et al*. 2001, p. 83). These six species are: *B. minor*, *B. pacificus*, *B. major*, *B. luciae*, *B. incognitus*, and *B. gavilanensis*.

Slender salamanders (*Batrachoseps* spp.) are extremely sedentary as evidenced by the extensive differentiation across relatively small geographic areas (Jockusch *et al*. 2001, pp. 81-83).

elj 1/6/19 2:03 PM
Comment [7]: change CA to western North America, or alternatively change 21 to 20 (21 species of Batrachoseps; 20 occur in CA)

elj 1/6/19 6:44 PM
Comment [8]: I would modify to say as a portion of a single species (since B. pacificus still exists—with all subspecific lineages of the former B. pacificus complex raised to species status)

elj 1/6/19 2:10 PM
Comment [9]: now 7 described species; Jockusch et al. 2015, p 80

elj 1/6/19 2:06 PM
Comment [10]: 7th species now included is is B. gabrieli

Based upon cytochrome *b*, divergence time estimates of lesser slender salamander separation from its closest geographically located congeners in the *B. pacificus* group are, in millions of years before present: *B. luciae* 17.3-6.9, *B. incognitus* 9.8-3.9, and *B. gavilanensis* 16.3-6.5 (Jockusch *et al*. 2001, pp. 86-87). Additionally, the lesser slender salamander is allopatric from these three species.

The lesser slender salamander is sympatric (occurring within the same geographical area of another species, overlapping in distribution) with another slender salamander species, *B. nigriventris* (Jockusch *et al*. 2001, p. 86), but they are paraphyletic (species descended from a common evolutionary ancestor or ancestral group, but not sharing/including all of the ancestor's descendant groups) (Jockusch *et al*. 2001, p. 82), as *B. nigriventris* resides in the *B. relictus* species group (Jockusch *et al*. 1998, p. 14). Additionally, they do not share niches within coinciding areas of similar habitat (e.g., oak woodland). The lesser slender salamander is typically found on slopes with rocky outcrops, with a dense understory of poison oak, while *B. nigriventris* is typically found on flatter ground with a dense cover of leaf litter and grasses (S. Sweet pers. comm. 2017).

3.4 Summary – Species Background

In 2001, the lesser slender salamander was described as a unique species based primarily on genetics, and also morphology (Jockusch *et al*. 2001, entire). The lesser slender salamander is 1 of 21 species of slender salamanders that occur in California. The species has the smallest average adult size of all slender salamanders and has a robust body and relatively long legs and tail for its size when compared to other slender salamander species.

4.0 HISTORICAL ABUNDANCE, RANGE, AND DISTRIBUTION

4.1 Range

Slender salamanders in the genus *Batrachoseps* range almost continuously along the Pacific Coast from about 62 miles (100 km) north of the California border in Curry County, Oregon, to about 186 miles (300 km) south of the California border near El Rosario, Baja California Norte, Mexico (Jockusch *et al*. 2001, pp. 54-55.)

The range of the lesser slender salamander extends less than 30 linear miles, and it occurs entirely within the Santa Lucia Mountain Range in San Luis Obispo County, California (Jockusch *et al*. 2001, p. 66).

elj 1/6/19 2:07 PM
Comment [11]: italicize gene name

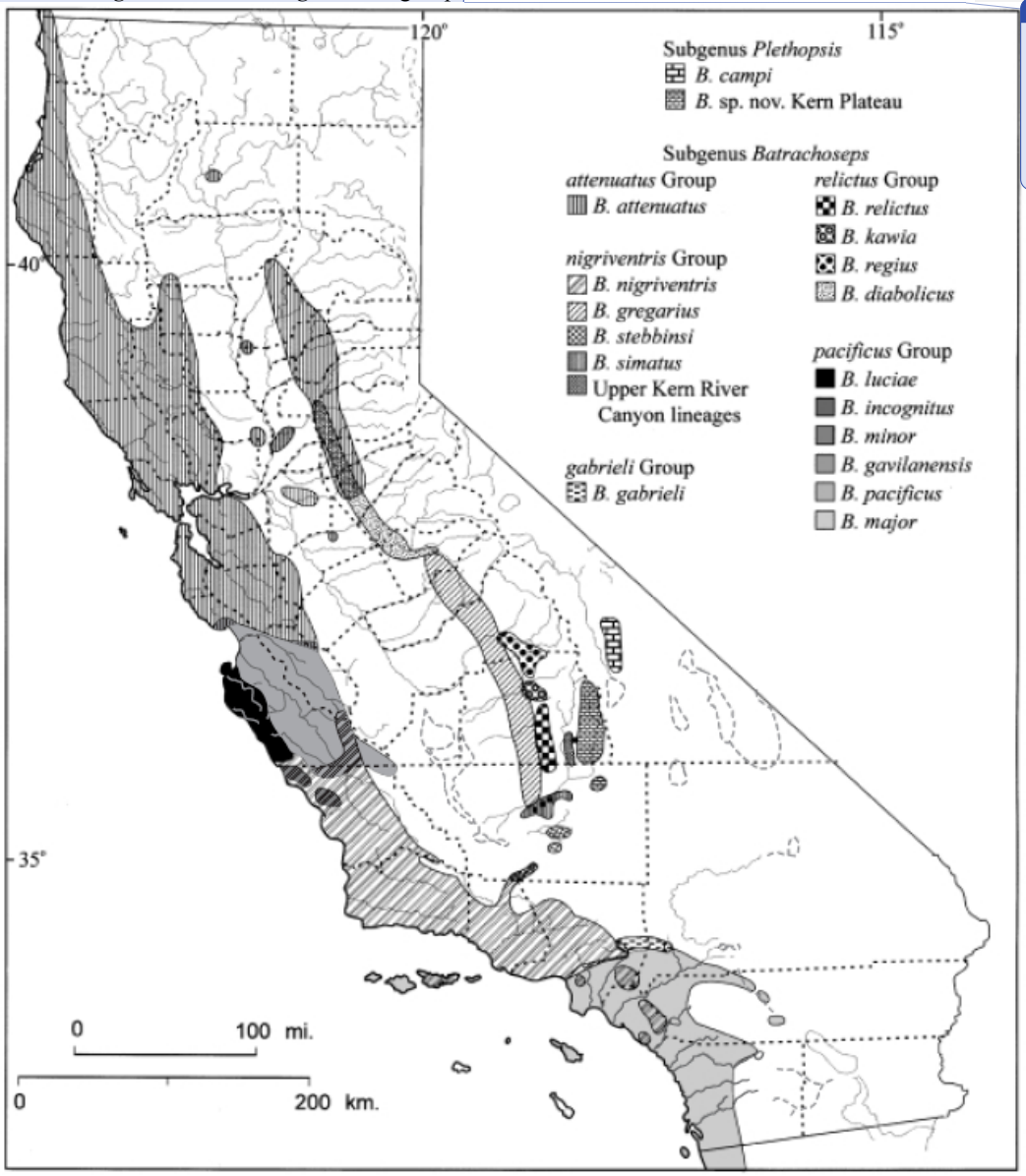
elj 1/6/19 8:55 PM
Comment [12]: The sentiment is correct, but the precise wording is not.
I would recommend revising to "but they are not closely related within *Batrachoseps*, as *B. nigriventris* resides in the *B. nigriventris* species group (Jockusch et al. 2015, p. 74)

elj 1/6/19 2:12 PM
Comment [13]: I would modify slightly—certainly in the old days, they were found essentially side-by-side, and in my limited experience, I have also found them that way.
recommended phrasing: Additionally, they have differentiated niches within.....

elj 1/6/19 2:12 PM
Comment [14]: 21 in western North AM. or 20 in CA

elj 1/6/19 2:13 PM
Comment [15]: This omits B. wrighti—in northern/central OR

Figure 2. Distribution of 18 described species and several lineages corresponding to undescribed species of *Batrachoseps* in California from Jockush and Wake (2002, p. 364). Note that *B. minor* is geographically distinct from other species in the *pacificus* group, but its range overlaps with that of *B. nigriventris* of the *nigriventris* group.



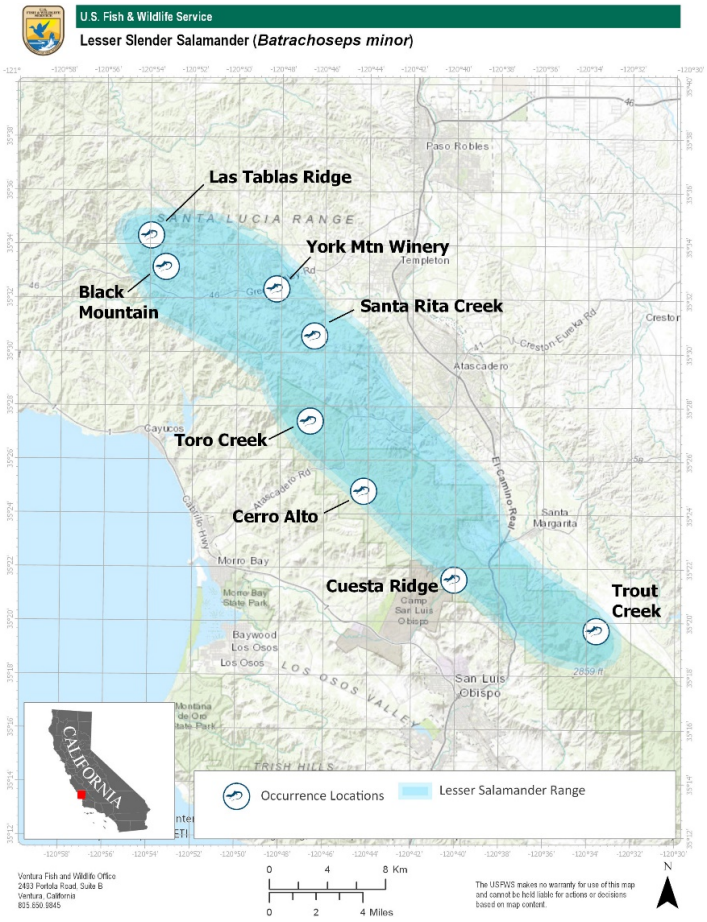
elj 1/6/19 2:15 PM

Comment [16]: Suggest update with Jockusch et al. 2015, FIgure 1a map, since taxonomy has been updated, and groups renamed since this figure. I'm happy to provide a version of that figure without the population numbers
I would also recommend adding an arrow to highlight the location of minor—it's hard to pick out from this!

4.2 Distribution

Eight occurrences of the lesser slender salamander have been found at locations along the Santa Lucia Range in San Luis Obispo County, California. From north to south the occurrence locations are referred to as: (1) Las Tablas Ridge, (2) Black Mountain, (3) York Mountain, (4) Santa Rita Creek, (5) Toro Creek, (6) Cerro Alto, (7) Cuesta Ridge, and (8) Trout Creek (S. Sweet pers. comm. 2017.). We define "occurrences locations" as the locality where lesser slender salamanders have been found. Two of the 8 occurrence locations are on U.S. Forest Service Lands (Cerro Alto and Cuesta Ridge: Los Padres National Forest, Santa Lucia Ranger District); the other 6 occurrence locations are on private land.

Figure 3. Eight occurrence locations of *B. minor* as described by Dr. Samuel Sweet of University of California, Santa Barbara, in August 2017.



elj 1/6/19 1:47 PM
Comment [17]: This misses or lumps two localities: Atascadero Creek (historic locality) and Cerro Alto/Morro Creek (discovered 2008)

elj 1/6/19 2:15 PM
Comment [18]: see figure I'm sending—could say with the addition of 1 historic locality vouchered in MVZ, or something along those lines.

The Las Tablas Ridge occurrence location is near Cypress Mountain Road, which is west of U.S. 101 and north of California Highway 46, and is on private land.

The Black Mountain occurrence location is along north facing slopes in the vicinity of Black Mountain, which is west of U.S. 101 and north of California Highway 46, and is on private land.

The York Mountain occurrence location is along northeast facing slopes adjacent to York Mountain Road, which is west of U.S. 101 and north of California Highway 46, and is on private land.

The Santa Rita Creek occurrence location is along north facing slopes adjacent to Santa Rita Creek Road, which is west of U.S. 101 and east of Old Creek Road, and is on private land. At present, this is the most extensive occurrence comprised of multiple locations where lesser slender salamanders have been observed. (S. Sweet pers. comm. 2015).

The Toro Creek occurrence location is along the old Highway 41, which is west of U.S. 101 and north and west of (current) California Highway 41, and is on private land but within the Los Padres National Forest boundary.

The Cerro Alto occurrence location is within a U.S. Forest Service recreation area of the Los Padres National Forest, Santa Lucia Ranger District, with a campground and hiking trails, which is west of U.S. 101 and south of California Highway 41. There is no Forest Service management plan in place for the Los Padres that includes amphibian management. There is a forest-wide management plan that outlines general approaches to forest management, and management plans are developed on a project-by-project basis (Cooper pers. comm. 2018).

The Cuesta Ridge occurrence location is at the Cuesta Ridge Botanical Reserve on U.S. Forest Service lands, Los Padres National Forest, Santa Lucia Ranger District, which is west of U.S. 101 and south of California Highway 41.

The Trout Creek occurrence location is along northwest facing slopes adjacent to a forest road near the junction of Water Canyon and Trout Creek, which is east of U.S. 101 and south of California Highway 58, and is on private land but within the Los Padres National Forest boundary.

4.3 Abundance

The abundance of lesser slender salamanders is not well known rangewide or at any of the occurrences. Surveys for lesser slender salamanders have been irregular since the 1970s and we are not aware of any studies having been conducted to estimate lesser slender salamander abundance that would inform trends in the numbers of individuals in any occurrence over time.

4.4 Summary – Historical Range, Distribution, and Abundance

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Comment [19]: Add before this: The Atascadero Creek locality is on current California Highway 41, west of U.S. 101, and is on private land

elj 1/6/19 9:00 PM

Comment [20]: field experience makes it clear that the relative proportion of B. nigriventris vs. B. minor in sympatric localities Black Mountain, York Mountain and Santa Rita Creek have all shifted towards a higher proportion of B. nigriventris. (At Atascadero Creek, only nigriventris has been found, but historic records are too limited to make inferences about proportions in the 1970s.) This does not address absolute abundances, of course, but the data—even in their current ancesdotal/museum record form—support a shift in relative proportion.

The lesser slender salamander has been observed in eight occurrence locations that occur entirely within the Santa Lucia Mountain Range in San Luis Obispo County, California. Two of the 8 occurrence locations are on U.S. Forest Service Lands (Cerro Alto and Cuesta Ridge: Los Padres National Forest, Santa Lucia Ranger District); the other 6 occurrence locations are on private land. Abundance data for the lesser slender salamander is not well known rangewide or at any of the eight occurrences.

5.0 LIFE HISTORY

5.1 Breeding

Little is known specifically about lesser slender salamander breeding; however, information is available for the Plethodontid family and *Batrachoseps* genus of slender salamanders.

Plethodontid salamanders reproduce on land and do not require an aquatic larval phase (Stebbins and McGinnis 2012, p. 104). This is attributed to the egg's large yolk in which the embryo goes through the gilled larval stage to hatch as a miniature adult (Stebbins and McGinnis 2012, p. 104). Slender salamander (*Batrachoseps* spp.) eggs are fertilized internally, and when laid, are connected to one another by filaments resembling a string of beads (Stebbins and McGinnis 2012, p. 106). Most slender salamanders (*Batrachoseps* spp.) lay their eggs in fall, after the first rains that end the summer dry period, and embryos develop over the winter months (Stebbins and McGinnis 2012, p. 105, 125). Eggs require a damp, concealed location that will remain moist over the several-month development period (Stebbins and McGinnis 2012, p. 104). A moist egg capsule is needed for the passage of oxygen to the gills of the embryo, which are pressed against the inner surface of the egg capsule (Stebbins and McGinnis 2012, p. 65). The nest site is usually a moist rock crevice, under bark of a rotting log, or a ground cavity (Stebbins and McGinnis 2012, p. 64).

5.2 Life Cycle

The lesser slender salamander life cycle is comprised of an egg, juvenile, and adult. There are no data specific to the details of the life cycle of the lesser slender salamander. Maiorana (1976, entire) examined the life-history patterns of *Batrachoseps attenuatus* and reported that at the beginning of their first dry season, hatchlings are approximately one-tenth the weight of an average adult and therefore may have lower survival rates than adults through periods of prolonged drought and reduced food sources (Maiorana 1976, p. 605). She also reported that in woodland habitat, 95% of adult female *B. attenuatus* reproduce each year and lay 7 to 8 eggs, and maturity is at 2.5 years (3 dry seasons). Data on longevity were not available, but a long adult life was suggested, potentially up to 6 years (Maiorana 1976, p. 605-606).

5.3 Feeding

Slender salamander (*Batrachoseps* spp.) food includes newly hatched earthworms (Class Oligochaeta), small slugs (Class Gastropoda), spiders (Class Arachnida), large mites (Class Arachnida), juvenile snails (Class Gastropoda), millipedes (Class Diplopoda), sowbugs (Order

elj 1/6/19 2:19 PM
Comment [21]: nine

elj 1/6/19 2:16 PM
Comment [22]: 9

elj 1/6/19 2:17 PM
Comment [23]: 7

elj 1/6/19 2:19 PM
Comment [24]: recommend changing 'require' to 'have'

elj 1/6/19 2:20 PM
Comment [25]: I think this goes substantially beyond what is actually known: when we find eggs, they are typically in places like this, but the total report of eggs in the wild is very low, suggeting that we don't know th e main sites.

elj 1/8/19 10:20 PM
Comment [26]: Wake and Castanet 1995, J. Herp. 29:60-65, used skeletochronology to study age in B. attenuatus; they found that adults were 4-8 years old

elj 1/8/19 10:21 PM
Comment [27]: I cannot find a source for the newly hatched earthworms (beyond Stebbins)—I could not trace it back to a primary literature report! I am asking around in case, e.g., someeone knows it's in Stebbins field notes).

My review of the primary literature would sugget that this should be revised somewhat, with an emphasis more like this:
mites, collembolans and gastropods are numerically the main documented food sources; other food sources include Diptera and other insects, spiders, isopods, earthworms

Adams 1968 (attenuatus?-check locality): Of the 222 food items removed from the stomachs of the five salamanders, there were 127 insects, 25 snails, 5 pill bugs, 63 mites, and 2 spiders

Bury and Martin 1973 (attenuatus): Collembola, Diptera, mites, spiders, Pulmonata (snails + slugs, lumped)

Lynch 1985 (attenuatus): working through data, conclude that mites, collembolans are rel. important, but they may not be the only important food times

Maiorana (1978) (attenuatus)
mites, aphids (+ snails, collembolans, dipterans)

Cunningham (1960), B. major
observations of eating (more likely for larger prey); no stomach contents examined
earthworm; various annelid worms, earwig; Sow bugs most frequent

Isopoda), and other small invertebrates that inhabit surface-litter areas and subterranean openings (Stebbins and McGinnis 2012, p. 127).

5.4 Sheltering

Little is known specifically about lesser slender salamander sheltering; however, information is available for the Plethodontid family and *Batrachoseps* genus of slender salamanders. During the daytime, Plethodontid salamanders inhabit moist places under rocks, bark, logs, within rotten wood, and in animal burrows, and they emerge at night when moisture conditions are suitable (Stebbins 2003, p. 168). Slender salamanders (*Batrachoseps* spp.) have been found in damp locations under logs, bark, and rocks, in leaf litter and termite galleries, and in crevices of rocks, logs, and stumps (Stebbins 2003, p. 183).

5.5 Summary – Life History

Lesser slender salamanders reproduce on land and do not require an aquatic larval phase. Eggs are laid in concealed, damp locations that will remain moist for the duration of embryo development. At hatching, lesser slender salamander juveniles are similar to adults in morphology but smaller in body size. Lesser slender salamanders feed on a variety of small invertebrate prey found under logs and rocks or in the other small crevices and underground shelters in which they reside.

6.0 GENERAL HABITAT DESCRIPTION

Habitat for the lesser slender salamander is comprised of shaded slopes with deep leaf litter and an abundant understory of poison oak (*Toxicodendron diversilobum*) (Jockusch *et al*. 2001, p. 66). The species occurs in wooded habitats containing tanbark oak (*Notholithocarpus densiflorus*), coast live oak (Q*uercus agrifolia*), blue oak (*Quercus douglasii*), sycamore (*Platanus racemosa*), and California laurel (*Umbellularia californica*) (Stebbins and McGinnis 2012, p. 137), and with abundant lower story vegetation dominated by poison oak (Jockusch *et al*. 2001, p. 66). The lesser slender salamander prefers closed-canopy northward facing steeper slopes with rock outcrops and shallow soil (S. Sweet pers. comm. 2017) and are typically found at an altitude above 1300 feet (400m) (Jockusch *et al*. 2001, p. 66).

elj 1/6/19 7:02 PM
Comment [28]: I would update this given recent discoveries
Toro Creek elev. ca. 825 ft.
Atascadero Creek: ca. 1100 ft
Trout Creek elev. ca. 1200-1300 ft
Santa Rita elevs. ca. 1100 ft

7.0 SPECIES NEEDS

7.1 Individual Needs

Lesser slender salamanders require habitat comprised of terrestrial areas with small interstitial spaces, such as earthworm burrows, rock crevices, or under wooden debris (logs). These small spaces allow individuals to hide from larger predators and also provide the small invertebrate prey needed by lesser slender salamanders for feeding. Moist areas within lesser slender salamander habitat are required for breeding to maintain moisture for developing embryos within eggs and required by individuals to avoid desiccation over the typically long periods without rainfall (California summer).

7.2 Population Needs

Population dynamics of the lesser slender salamander are not well understood. Lesser slender salamander populations need suitable habitat that supports survival of individuals and an adequate number of reproducing individuals with vital rates that maintain self-sustaining populations despite stochastic events.

7.3 Species Needs

The lesser slender salamander needs multiple resilient populations distributed across the range of the species.

7.4 Resiliency, Representation, and Redundancy

Resiliency

Resiliency describes the ability of the populations to withstand stochastic events. Measured by the size and growth rate of each population, resiliency gauges the probability that the populations comprising a species are able to withstand or bounce back from environmental or demographic stochastic events.

Lesser slender salamander population-level resiliency is a function of its size and its growth rate. A resilient lesser slender salamander population is one that is self-sustaining and has suitable habitat for feeding, breeding, and sheltering.

Representation

Representation describes the ability of a species to adapt to changing environmental conditions. Measured by the breadth of genetic or environmental diversity within and among populations, representation gauges the probability that a species is capable of adapting to environmental changes.

Representation in the lesser slender salamander is important across the range of the species. Although we expect local endemics, such as the lesser slender salamander, to naturally harbor less adaptive capacity than wide-ranging species. Species that span environmental gradients (spatially and temporally heterogeneous environments) are expected to harbor the most phenotypic and genetic variation (Lankau *et al*. 2011, p. 320). Thus, preserving the breadth of diversity of a species requires maintaining populations across historical latitudinal, longitudinal, and elevation gradients, as well as climatic gradients. We do not have information on the genetic diversity for lesser slender salamanders but assume that maintenance of resilient occurrences across the north-south and east-west gradients within its historically limited distribution is representation for the species.

Redundancy

Redundancy describes the ability of a species to withstand catastrophic events. Measured by the number of populations, their resiliency, and their distribution (and connectivity), redundancy gauges the probability that the species has a margin of safety to withstand or can bounce back from catastrophic events.

Lesser slender salamander redundancy is a function of the number and distribution of resilient populations across the range relative to the degree and spatial extent of potential catastrophic events. Distribution is related to the number of occurrences. Catastrophic events which could affect lesser slender salamander occurrences include disease, widespread drought and periods of extreme heat resulting in the loss of soil moisture in lesser slender salamander habitat, catastrophic wildfire, and torrential rainstorms resulting in sediment/debris flows or widespread flooding.

7.5 Summary -- Species Needs

Lesser slender salamanders require habitat comprised of terrestrial areas with small interstitial spaces needed to hide from predators and for feeding, and that are moist to meet the species' requirements for breeding. A resilient lesser slender salamander population is one that is self-sustaining and has suitable habitat for feeding, breeding, and sheltering. Representation in the lesser slender salamander is maintained by preserving the breadth of diversity across historical range. Lesser slender salamander redundancy is a function of the number and distribution of resilient populations across the range relative to the degree and spatial extent of potential catastrophic events, such as disease, widespread drought, wildfire, and flood effects.

8.0 CURRENT CONDITIONS

8.1 Abundance and Distribution

Prior to 2015, the lesser slender salamander was known to occur in six locations. Since that time, two additional locations have been discovered. The lesser slender salamander is currently known to be present in all eight occurrence locations (S. Sweet pers. comm. 2017).

The Las Tables Ridge, Black Mountain, York Mountain, Santa Rita Creek (from where the holotype was collected in 1975), Cerro Alto, and Cuesta Ridge are historical occurrence locations (Jockusch *et al*. 2001, p. 65-66).

Individual lesser slender salamanders were observed at Las Tablas Ridge, Black Mountain, York Mountain, Santa Rita Creek, Cerro Alto, and Cuesta Ridge occurrences in 2011 (S. Sweet pers. comm. 2017).

The Toro Creek occurrence was discovered in 2016 (S. Sweet pers. comm. 2017) and the Trout Creek occurrence was discovered in 2015 (S. Sweet pers. comm. 2016).

Current abundance for the lesser slender salamander at each occurrence is unknown. The data required to make abundance estimates for each occurrence are lacking and therefore population estimates cannot be made at this time.

elj 1/6/19 2:33 PM
Comment [29]: Most recent documented sightings at 3 historic localities are 1970s (Black Mountain, Atascadero Creek, Cuesta Ridge)

elj 1/6/19 2:32 PM
Comment [30]: nine

elj 1/6/19 2:34 PM
Comment [31]: This locality was discovered after the species was described. But there is a historic locality W of Atascadero on Hwy. 41 in the Atascadero Creek drainage;
Jockusch et al. 2001 were tentative about the identity of the Cuesta Ridge locality, stating that it hadn't been examined by sequence or allozymes. This turns out to be incorrect. There were allozyme data, on the basis of which had been identified as B. luciae, like all B. minor.
Cerro Alto locality was discovered in 2008 (by Iñigo Martinez-Solano and me);voucher is MVZ 266828. I am quite certain that Sam Sweet has not found additional individuals there since, as we have taken several trips together trying to find them, and all we've ever had to show for it is cases of poison oak (and, if we're lucky, some B. ngiriventris, as well)

elj 1/6/19 7:04 PM
Comment [32]: I believe this must represent a misunderstanding—at each of these sites, only a single indiv. has ever been reported, in 2008 and 1977 respectively; I am also nearly certain that animals have not been found at Black Mountain since the 1970s.

Table 1. Historic and current distribution of *B. minor*

Occurrence	Historic	Current
Las Tables Ridge	X	Present in 2011
Black Mountain	X	Present in 2011
York Mountain	X	Present in 2011
Santa Rita Creek	X	Present in 2011
Cerro Alto	X	Present in 2011
Cuesta Ridge	X	Present in 2011
Toro Creek	--	Discovered in 2016
Trout Creek	--	Discovered in 2015

We evaluated potential threats to the lesser slender salamander, including habitat loss, pesticide drift, road mortality, climate change, and disease. We evaluated overutilization, collection, and predation to see if they were actually occurring or were a significant problem, and we did not find any information to indicate that they are a concern for the lesser slender salamander now or into the future.

Dr. Samuel Sweet, Professor, University of California, Santa Barbara, conducted graduate work on the lesser slender salamander in the 1970s and in the winter of 2011 began to reinvestigate the status of the species. According to Dr. Sweet, lesser slender salamanders were easily found recently at all recorded localities and numbers may be reduced compared to the 1970s, but this is true for all plethodontid (lungless) salamanders in central California as a consequence of extended drought, but more generally as a result of a long-term climatic shift driven by the Pacific Decadal Oscillation.

Dr. Sweet provided the following related to threats to the species (S. Sweet pers. comm. 2015):

- Habitat loss—In the areas inhabited by lesser slender salamanders there has been no habitat change of any kind in over 45 years. York Mountain Vineyards and Winery have not farmed grapes on site since its main building was destroyed in the 2003 San Simeon earthquake, and only recently (2015) replanted in the original footprint.

- Pesticide drift—Lesser slender salamanders living nearby the winery do not seem to be affected.

- Road mortality—In the California Roadkill Observation System, as of September 27, 2015, no roadkill of lesser salamanders has been reported.

- Climate change—This is a major factor for all native amphibians in California.

- Disease—The fungal disease, *Batrachochytrium dendrobatidis* (Bd), may be affecting the lesser slender salamander (S. Sweet pers. comm. 2017).

elj 1/6/19 2:35 PM
Comment [33]: Should be Las Tablas—Cypress Mountain may be a better name for it;

elj 1/6/19 2:37 PM
Comment [34]: To my knowledge, including records from Sam Sweet, not seen since 1970s. I suggest rechecking with Sam about this—and also about the extent to which he has been able to search there, which is likely limited

elj 1/6/19 2:36 PM
Comment [35]: Add row above: Atascadero Creek—historic.

For Cerro Alto—discovered in 2008; only 1 individual found (and none since then)

elj 1/6/19 2:37 PM
Comment [36]: Known from a single specimens in the 1970s; I have made several trips—including with Sam Sweet—we have not found any additional animals

elj 1/6/19 2:39 PM
Comment [37]: This is all true, but I would recommend adding that the relative of abundance of B. minor compared to B. nigriventris appears to be lower than it was in the 1970s, at least at some sites.

The Service accessed *AmphibiaWeb* on March 27, 2017 (http://amphibiaweb.org/cgi/amphib_query?where-genus=Batrachoseps&where-species=minor), which states: "Fewer than five of these [lesser slender] salamanders have been seen in the past decade despite many attempts to find them. Although some areas within the historical range of this species have been modified for agriculture (i.e., conversion to vineyards), ample habitat remains and there is no obvious reason for this decline in abundance." Although land was converted several decades ago for the York Mountain Vineyards and Winery, this land conversion occurred adjacent to, but not within, habitat for the lesser slender salamander.

elj 1/6/19 7:07 PM

Comment [38]: Also worth noting that their information on number of individuals seen in the past decade is out-of-date (presumably could cite Sweet pers. comm.—I am assuming he has provided you with his count data?)

We have been unable to find any data suggesting that pesticide drift is a threat to the lesser slender salamander or its habitat.

The Service accessed the California Roadkill Observation System (http://www.wildlifecrossing.net/california/) on August 21, 2018, and found no records documenting road mortality of lesser slender salamanders (or any other slender salamander species). Our search corroborates the information provided by Dr. Sweet regarding the lack of data supporting road mortality as a threat to lesser slender salamanders.

Batrachochytrium dendrobatidis (Bd) is a fungal pathogen which can cause chytridiomycosis, a highly infectious amphibian disease associated with mass die-offs, population declines and extirpations, and potentially species extinctions on multiple continents (Berger *et al*. 1998, pp. 9031-9036; Bosch *et al*. 2001, pp. 331-337; Lips *et al*. 2006, pp. 3165-3166).

The best available information we have regarding the lesser slender salamander has led us to determine that we need to consider further how climate change and disease are impacting the viability of the lesser slender salamander in this SSA now and into the future.

8.3 Potential Threats

8.3.1 Changes in Climate Conditions

The summer of 2017 was the warmest in California since record keeping began in the late 1800's (NOAA National Centers for Environmental Information 2018). Considering data up to 2015, Brown *et al*. (2016, entire) reported that most of the warming occurred in the past 35 years with 15 of the 16 warmest years occurring since 2001. The 3-year period from 2012 to 2014 was the hottest and driest in California in the 100-year timeframe considered (Mann and Gleick 2015, p. 3858), and it was the most severe drought in California in the past 1,200 years (Griffin and Anchukaitis 2014, p. 9017). According to Thorne *et al*. (2017, entire), this trend appears likely to continue; however recent projections for California indicate that while temperatures will significantly increase, no significant change in precipitation is predicted (He *et al*. 2018, entire). Also, He *et al*. (2018, p. 17) reports a decreasing tendency for severe droughts.

The lesser slander salamander is a Priority 2 (out of 3) taxon for drought vulnerability based on the California Department of Fish and Wildlife's rapid assessment of the vulnerability of sensitive California wildlife to extreme drought (CDFW 2016, p. 28). Drought vulnerability was assessed for special status amphibians, reptiles, birds, and mammals using scores for three risk

categories and three life history/status criteria. Priority 1 were those taxa found to be most vulnerable to extended or frequent severe drought and resultant risk of extirpation. Priority 2 was created to capture taxa that have an elevated drought risk but do not meet the conditions of high priority taxa, which were placed in Priority 1. Priority 3 included all other taxa evaluated with lower drought risk.

Current effects to the lesser slender salamander from increased temperatures due to climate change include, but are not limited to: reduction of cool, moist areas that supply habitat and reduced survival of all life stages. During the daytime, Plethodontid salamanders inhabit moist places under rocks, bark, logs, within rotten wood, and in animal burrows, and they emerge at night when conditions are suitable. Slender salamanders use damp locations under logs, bark, and rocks, in leaf litter and termite galleries, and in crevices of rocks, logs, and stumps, suggesting that they may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. The species may continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a current population-level effect.

8.3.2 Disease

Disease has the potential to cause catastrophic loss of lesser slender salamanders. There are two pathways by which disease could result in a catastrophic mortality event for the lesser slender salamander. Mortality events could be caused by existing pathogens or through the introduction of novel pathogens.

The chytrid fungus *Batrachochytrium dendrobatidis* (Bd) was identified in 1999 and has been attributed to the primary cause of decline for many amphibians. Bd is a fungal pathogen that can cause chytridiomycosis and it has been documented in wild lesser slender salamander individuals. A second type of chytrid fungus (*Batrachochytrium salamandrivorans*, Bsal) is emerging in Europe. While Bsal primarily affects salamanders, frogs can also become infected and spread this disease. Additionally, the disease Ranavirus has been documented in northern California but has not been observed in lesser slender salamanders, but could be spread into the range of the lesser slender salamander.

Given the high risk of *Bsal* invasion, the Service recently listed 20 amphibian genera known to carry *Bsal* as injurious under the Lacey Act to limit importation into the United States (USFWS 2016, entire). Despite this protection, it is possible that an unknown carrier or illegal import could introduce this pathogen into salamander populations in California.

Emerging infectious diseases (EIDs) have been increasing in large part because of globalization and the increased frequency and rapidity of international travel and trade (McLean 2007, p. 262; Brand 2013, p. 447; Smith *et al*. 2017, pp. 30-31). Global wildlife trade is a significant contributor and occurs mostly through uncontrolled or illegal networks, and involves millions of birds, mammals, reptiles, amphibians, and fish every year (Karesh *et al*. 2005, p. 1000; Smith *et al*. 2017, pp. 30-31). Increasingly, disease is being recognized as a driver of population declines and extinctions (Brand 2013, p. 447; McPhee and Greenwood 2013, p. 6), and amphibians are

one of the vertebrate groups most negatively impacted by the introduction of EIDs world-wide (Martel *et al*. 2014; Chambouvet *et al*. 2015; Berger *et al*. 2016, entire).

Batrachochytrium dendrobatidis

Batrachochytrium dendrobatidis (Bd) is a fungal pathogen which can cause chytridiomycosis, a highly infectious amphibian disease associated with mass die-offs, population declines and extirpations, and potentially species extinctions on multiple continents (Berger *et al*. 1998, pp. 9031-9036; Bosch *et al*. 2001, pp. 331-337; Lips *et al*. 2006, pp. 3165-3166). Bd attacks the keratinized tissue of amphibian skin and can lead to thickened epidermis, lesions, body swelling, lethargy, loss of righting reflex, and death in all life stages (Berger *et al*. 1998, pp. 9031-9036; Bosch *et al*. 2001, p. 331; Carey *et al*. 2003, p. 130). Chytridiomycosis infection rates among amphibians exposed to Bd vary by species (Woodhams *et al*. 2007, p. 4), and resistance to Bd infection in some amphibians is likely related to levels of antimicrobial peptides found in skin secretions (Woodhams *et al*. 2007, p. 4), beneficial skin bacteria (Harris *et al*. 2006, p. 55), and possibly frequent skin shedding (Woodhams *et al*. 2007, p. 6). The effects of chytridiomycosis can vary among host species and life stages (Gervasi *et al*. 2013) and can even vary between populations of the same species (Bradley *et al*. 2015). Resistance can be reversed under certain environmental conditions, for example those that can exert stress and immunosuppression (Ramsey *et al*. 2010). Thus, the prevalence of Bd (i.e., number of positives/number sampled) in different populations is likely reflecting the interaction between the host, the pathogen strain, and the environmental conditions they encounter (Spitzen-Van der Sluijs *et al*. 2014; Bacigalupe *et al*. 2017).

Lesser slender salamanders are susceptible to contracting chytrid. The U.S. Geological Survey (USGS) conducted an analysis of samples collected in 2017 from eight individual lesser slender salamanders. Their provisional results for Bd in lesser slender salamanders determined that, of the three occurrence locations from which samples were taken, all samples from two of the occurrence locations (Toro Creek and Santa Rita Creek) were Bd positive, while those from Trout Creek were negative for Bd (R. Fisher pers. Comm. 2018).

The prevalence of Bd in lesser slender salamanders is not known; however, a study was conducted on another slender salamander species that occurs in California, *B. attenuates* (Sette *et al*. 2015, entire). Sette *et al*. (2015) found Bd infection and spread in *B. attenuatus* in proximity to the greater Bay Area of northern California. From the museum specimens used in their study, Bd was first found in *B. attenuatus* during the 1960s (Sette *et al*. 2015, p. 24). Bd prevalence in *B. attenuatus* peaked in the 1990s, and in 2013 the prevalence of Bd in *B attenuatus* had decreased from the levels found in the 1990s (Sette *et al*. 2015, pp. 24-25).

The effects of Bd infection on lesser slender salamanders are not known; however, studies on the effects of Bd to two other slender salamander species that occur in California, *B. attenuatus* and *B. luciae*, have been conducted. Weinstein (2009, entire) conducted studies investigating the effects of Bd on *B. attenuatus*. Under one study, Weinstein (2009, p. 655) collected 30 living individuals of *B attenuatus* from the wild, 19 of which were determined to have been infected with Bd in the wild; 18 (95%) died within 70 days and all of the individuals infected with Bd died in the lab over the course of the approximate 120-day study, while 10 of 11 uninfected

individuals survived. In a second study, Weinstein (2009, pp. 654-657) collected individuals of *B. attentuatus* from the wild and infected them with Bd in the lab; those held in the experimental dry conditions (95% relative humidity) began reducing their zoospore counts after inoculation and all individuals lost their infections and survived more than 95 days. This suggests that slender salamanders could shed Bd infection during dry periods. Sparagon (2015) examined Bd susceptibility in individuals carrying wild Bd infections and individuals inoculated with lab grown Bd. Experiments demonstrated significant differences in *B. luciae* mortality rates from wild Bd and lab grown Bd infections. Those with wild infections had a 77.8% mortality rate; those infected in the lab had a 25% mortality rate, suggesting that *B. luciae* is susceptible to infection and death from wild Bd (Sparagon 2015, pp. 20-25).

The details of how Bd moves through the environment resulting in the spread of disease is not well understood, but could occur through reservoir species (Reeder *et al*. 2012, pp. 4-5). The Pacific chorus frog (*Pseudacris regilla*) is common and widespread across California (Stebbins and McGinnis 2012, pp. 180-181). Pacific chorus frogs can withstand high Bd zoospore loads without symptoms or mortality (Reeder *et al*. 2012, pp. 2-3). Additionally, four species of Pacific newts (Genus *Taricha*) are common and widespread across coastal California (Stebbins and McGinnis 2012, pp. 92-103) and may serve as a reservoir for chytridiomycosis in terrestrial salamanders (Chaukulkar *et al*. 2018, p. 6). Infected bullfrog (*Rana catesbiana*) tadpoles can also be effective vectors of Bd (Miaud *et al*. 2016, entire). Lesser slender salamanders do not have an aquatic phase, unlike Pacific chorus frogs and Pacific newts which require an aquatic larval phase, and the ability for Bd zoospores to survive can be reduced in dry terrestrial environments, potentially lessening the likelihood of Bd spread from reservoir species with an aquatic life stage to slender salamanders.

Batrachochytrium salamandrivorans

The fungal pathogen Bsal invaded Europe from Asia around 2010 and is responsible for causing mass die-offs of fire salamanders (*Salamandra salamandra*) in northern Europe (Martel *et al*. 2014, p. 631; Fisher 2017, p. 300-301). Given unregulated trade and the recent discovery of Bsal in amphibians, there is concern about the introduction of a novel pathogen causing extirpations of salamander populations in North America which have never been exposed to the disease (Yap *et al*. 2017, entire). While we still do not have a clear understanding of all of the salamander species that will be susceptible to Bsal, there is concern that lesser slender salamanders could be impacted. The Pacific coast, including the range of the lesser slender salamander, is one the regions with the highest risk of introduction of Bsal (Richgels *et al*. 2016, p. 5; Yap *et al*. 2015, p. 482) and highest risk of Bsal to native salamanders (Richgels *et al*. 2016, p.6).

Given the high risk of Bsal invasion, the Service recently listed under the Lacey Act 20 amphibian genera known to carry Bsal as injurious, in order to limit importation into the United States (Service 2016b, entire). The USGS conducted an analysis of samples collected in 2017 from eight individual lesser slender salamanders. Their provisional results for Bsal determined that of the three occurrence locations from which samples were taken, all samples were negative for Bsal (R. Fisher pers. Comm. 2018).

Ranaviruses

Ranaviruses are another emerging group of pathogens affecting amphibian populations worldwide. Ranavirus is one of five genera in the family Iridoviridae, a family of viruses known to infect a diversity of invertebrate and ectothermic (cold-blooded) vertebrate hosts. Ranaviruses were originally detected in frogs (Granoff *et al*. 1965, pp. 237-255; Rafferty 1965, pp. 11-17) but are now known to infect and cause disease in fish, reptiles, and other amphibians (Marschang and Miller 2012, p. 1). Ranaviruses are often virulent and can cause systemic infections in amphibians (Daszak *et al*. 1999, p. 742). Mortality caused by ranaviruses has been reported from five continents and in most of the major families of frogs and salamanders (Gray *et al*. 2009, pp. 243-244).

Amphibian larvae seem to be the developmental stage most susceptible to ranaviruses (Daszak *et al*. 1999, p. 742), with physical characteristics of infections in larval stages including skin hemorrhages, ulcers, and bloating (Marschang and Miller 2012, p. 1). Overt signs of infection may not be exhibited in juvenile and adult stages (Daszak *et al*. 1999, p. 742), but when present typically include skin abnormalities (e.g., sloughing, hemorrhaging) and sometimes necrosis (tissue death) of digits and limbs (Cunningham *et al*. 1996, pp. 1539, 1541; Jancovich *et al*. 1997, p. 163). The exact mechanism by which Ranavirus infections cause amphibian mortalities remains unclear, but hemorrhaging in skeletal tissue (Daszak *et al*. 1999, p. 743) and extensive necrosis in the liver, spleen, kidneys, and digestive tract have been observed in infected individuals (Gray *et al*. 2009, p. 253). It is also postulated that viral infections may suppress the immune system, resulting in secondary invasion by opportunistic pathogens (Miller *et al*. 2008, p. 448).

Sutton *et al*. (2015, entire) sampled fourteen species of Plethodontid salamanders (none from genus *Batrachoseps*) from Great Smoky Mountains National Park and tested the individuals for Ranavirus. Of the total 566 salamanders that were sampled, 103 were positive for Ranavirus, across 11 of the 14 species (Sutton *et al*. 2015, p. 324). Ranavirus outbreaks among lesser slender salamanders have not been documented.

8.4 Summary -- Current Condition

The lesser slender salamander is currently known to be present in all eight occurrence locations; presumably the species' current range is the same as its historic range. Current population abundance for the lesser slender salamander at each occurrence is unknown. The two threats that could be have the greatest impact on populations or rangewide are: (1) changing climate conditions, and (2) disease.

elj 1/8/19 10:29 PM

Comment [39]: In my view, this goes beyond the evidence. Since 2011, it has been found at 5 of 9 localities (including 2 newly discovered); it has not been reported at 3 historic localities and 1 locality known from a single specimen in 2008. At one of the historic localities (Black Mountain), B. minor used to be adundant; at the other, it is known from a single specimen in really tough field conditions—so my impression is that it required perfect conditions and luck to find the 1st individual, and would require the same to find another.

Current effects to the lesser slender salamander from increased temperatures due to climate change include, but are not limited to: reduction of cool, moist areas that supply habitat and reduced survival of all life stages. During the daytime, Plethodontid salamanders inhabit moist places under rocks, bark, logs, within rotten wood, and in animal burrows, and they emerge at night when conditions are suitable. Slender salamanders use damp locations under logs, bark, and rocks, in leaf litter and termite galleries, and in crevices of rocks, logs, and stumps, suggesting that they may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. The species may continue

to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a current population-level effect.

As for disease, Bd has been found in lesser slender salamanders, however the vulnerability of lesser slender salamanders to Bd infection and developing chytridiomycosis is unknown. Two congeners have differing susceptibility. In *B. attenuatus*, there is some level of susceptibility to infection, however it appears that Bd prevalence has been decreasing over time in this species. In contrast, *B. luciae* appears to be highly susceptible to Bd infection. While the lesser slender salamander has been shown to be susceptible to Bd there are no data to suggest current die-offs, and individual lesser slender salamanders may have the potential to shed the infection as habitat conditions become drier over the summer months, which would decrease the prevalence of disease in the population.

At this time, climate effects and disease are potential threats that could affect all salamander species. Currently the best available data indicates that climate change and disease will affect B. minor on an individual level. We do not anticipate that climate effects or disease are population-level threats to the species because B. minor is flexible in behavior and can find suitable habitat when faced with the effects of climate change and the prevalence of disease may be reduced due to drier conditions.

All of the previously discussed threats may act on the lesser slender salamander in combination and we evaluated all of these threats combined to examine the total effect on the species. In particular, threats such as habitat loss, road mortality, climate change and disease may act on the lesser slender salamander in combination to affect the species. Some minor habitat loss may occur along with random road mortalities and continued climate change effects with occasional disease could occur together to affect the lesser slender salamander. Yet, even cumulatively, there is little suggest that anything more than a few individuals are being currently affected. We evaluated the combined effects of pesticide drift, overutilization, collection or predation and we found no information to indicate that they are a concern for the lesser slender salamander under current conditions. The totality of effects from all of the identified threats is likely to affect the lesser slender salamander on the individual scale, but we do not anticipate that these combined effects are having negative impacts at the population- or on the species-wide scale.

8.5 Summary Current Condition – Resiliency, Representation, and Redundancy

We do not have data to determine the resiliency of lesser slender salamander populations. Resiliency is positively related to population size and growth rate and may be influenced by connectivity among populations. We would need information on abundance, growth rate, or an acceptable proxy to determine resiliency and currently no data are available to us. At this time, the best available information indicates that the species is extant at all eight occurrence locations. These occurrence locations encompass the north-south and east-west gradients within its limited distribution, presumably maintaining the relevant adaptive capacity for the species that comprises representation. While redundancy will always be very limited for local, endemic species with a naturally limited range, we believe the lesser slender salamander would be able to withstand a catastrophic event because having 8 populations likely provides them with enough redundancy to recover from such a loss.

elj 1/6/19 6:10 PM
Comment [40]: Agreed—there are no formal data. But I think there's good evidence that it hasn't fully bounced back to 1970s numbers (for reasons unknown)

elj 1/6/19 6:10 PM
Comment [41]: 9

9.0 POTENTIAL FUTURE CONDITIONS

We use 25 years as our future timeframe as it encompasses 1-2 regular drought cycles in California and encompasses projections for climate change. We forecast the status of the lesser slender salamander after 25 years under two plausible future scenarios, one with continued climate-related effects and disease at the current level, and a second with continued climate-related effects and increased disease susceptibility.

9.1 Changes in Climate Conditions

Changes in climate have been observed in recent years and are predicted to continue in California (Frankson *et al*. 2017, p. 1). This can include extreme events such as multi-year droughts or heavy rain events (Frankson *et al*. 2017, pp. 2–5). Pierce *et al*. (2013, entire) estimated future changes in temperature and precipitation patterns in California by the 2060s and determined that historically maximum July temperatures are likely to increase and heat waves may span longer durations. Summer temperatures are anticipated to increase along the central coast of California (Pierce *et al*. 2013, p. 843 figure 2b), which could lead to increased evapotranspiration (Diffenbaugh *et al*. 2015, p. 3994). Droughts associated with increased warming in California are anticipated to increase (Diffenbaugh *et al*. 2015, p. 3934; Williams *et al*. 2015, p. 6826; Cook *et al*. 2015, p. 6). Additionally, Cvijanovic *et al*. (2017, p. 8) identified that as the Artic sea-ice cover decreases, precipitation amounts in California decrease, resulting in the potential increase in future droughts in California. Dettinger (2011, pp. 521-522) determined that in the future, extreme storm events may increase in severity beyond historic levels of intensity with potential to increase flood risks and to increase the potential for flooding to occur before and after the primary historical flood season in California.

He *et al*. (2018, p. 4) evaluated historical and projected precipitation and maximum and minimum temperature data, and developed projections for 2020–2099 based on climate model simulations for hydrologic basins of California. The study used two 40-year future periods, mid-century (2020–2059) and late-century (2060–2099), which was compared to a historical (baseline) period of 1951–1990 (He *et al*. 2018, p. 6). All projections on mean annual maximum temperature and minimum temperature showed significant increasing trends. However, no significant trends were detected in historical annual and wet season precipitation for any study regions (He *et al*. 2018, p. 14-15). When looking at drought projections, there was no consensus among projections; however, the majority of projections show a decreasing tendency for severe droughts due to increase in annual precipitation (He *et al*. 2018, p. 17). While there were no significant trends in precipitation for any study regions, most regions are also expected to see an increase in annual precipitation, with the Central Coast region experiencing a +6.4% under RCP 4.5 scenario by mid-century, and an increase of +6.2% by late-century (He *et al*. 2018, pp. 8–9; Figure 4a, 4c).

Overall, projections of climate change along the central coast of California indicate that temperature will increase over the next 25 years. Patterns of precipitation in the future are less clear; however, when storms do occur, they will likely be more severe than historical/baseline conditions.

9.2 Disease

Bd has been confirmed in the lesser slender salamander but the specific effects of Bd infection in wild individuals and how this might change in the next 25 years is unknown. Some amphibian species appear to be tolerant of infection from Bd, while others experience extirpation (Louca *et al*. 2014, entire). Padgett-Flohr and Hopkins (2009, entire) evaluated museum specimens and found that Bd has been in central California since at least 1961, suggesting Bd is now endemic throughout most of central California, (Padgett-Flohr and Hopkins 2009, p. 8).

Xie *et al*. (2016) projected how climate may influence Bd distribution globally into the future (Xie *et al*. 2016, entire). They found that Bd ranges will shift into higher latitudes and altitudes (Xie *et al*. 2016, p. 14) but did not project future virulence in areas where Bd already occurs. Changes in climate could create situations (e.g., microclimate suitable for the pathogen, shifting species distributions) that shift the pattern for Bd, which could increase or decrease disease risk for the lesser slender salamander and other amphibians (e.g., Adams *et al*. 2017, entire).

For Bsal, Richgels *et al*. (2016, entire) predict that the Pacific coast, southern Appalachian Mountains and mid-Atlantic regions will have the highest relative risk from Bsal, if it were to get into the United States. Given the high risk of Bsal invasion, the Service recently listed 20 amphibian genera known to carry Bsal as injurious under the Lacey Act to limit importation into the United States (USFWS 2016, entire). Given this, we do not anticipate that Bsal is likely cause population-level declines in the lesser slender salamander in the next 25 years.

9.3 Cumulative Effects

All of the previously discussed threats may act on the lesser slender salamander in combination and we evaluated all of these threats combined to examine the total effect on the species. In particular, threats such as habitat loss, road mortality, climate change and disease may act on the lesser slender salamander in combination to affect the species. Some minor habitat loss may occur along with random road mortalities and continued climate change effects with occasional disease could occur together to affect the lesser slender salamander. Yet, even cumulatively, there is little suggest that anything more than a few individuals are being currently affected. We evaluated the combined effects of pesticide drift, overutilization, collection or predation and we found no information to indicate that they are a concern for the lesser slender salamander in the future. The totality of effects from all of the identified threats is likely to affect the lesser slender salamander on the individual scale, but we do not anticipate that these combined effects are having negative impacts at the population- or on the species-wide scale.

9.4 Future Scenario 1: Climate and Disease Continuation

Under Future Scenario 1 (Climate and Disease Continuation), we evaluated the status of the lesser slender salamander after 25 years with continued climate-related effects and disease at the current level. Projections of climate change along the central coast of California indicate that temperature will increase over the next 25 years. Patterns of precipitation in the future are less clear.

Current effects to the lesser slender salamander from increased temperatures due to climate change include, but are not limited to: reduction of cool, moist areas that supply habitat and reduced survival of all life stages. During the daytime, Plethodontid salamanders inhabit moist places under rocks, bark, logs, within rotten wood, and in animal burrows, and they emerge at night when conditions are suitable. Slender salamanders use damp locations under logs, bark, and rocks, in leaf litter and termite galleries, and in crevices of rocks, logs, and stumps, suggesting that they may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. The species may continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a current population-level effect.

As for disease, Bd has been found in lesser slender salamanders, however the vulnerability of lesser slender salamanders to Bd infection and developing chytridiomycosis is unknown. Two congeners have differing susceptibility. In *B. attenuatus*, there is some level of susceptibility to infection, however it appears that Bd prevalence has been decreasing over time in this species. In contrast, *B. luciae* appears to be highly susceptible to Bd infection in the wild. While the lesser slender salamander has been shown to be susceptible to Bd there are no data to suggest current die-offs. In this scenario, we assume that the lesser slender salamander is able to stave off a large-scale disease event due to similarity in disease susceptibility and trends to *B. attenuatus*. Given that currently we do not anticipate that disease is population-level threats to the lesser slender salamander, at this continued level and with similarity in disease susceptibility and trends to *B. attenuates,* we do not anticipate a population-level effect in the next 25 years.

9.5 Future Scenario 2: Climate Continuation and Increased Disease

Under Future Scenario 2 (Climate Continuation and Increased Disease), we evaluated the status of the lesser slender salamander after 25 years with continued climate-related effects and increased disease susceptibility. The climate portion of this scenario is the same as in Scenario 1 and therefore we anticipate that if current trends in climate continue, the species may be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a population-level effect in the next 25 years.

As for potential increase in disease, under this scenario we assume greater susceptibility to existing pathogens. Specifically, Bd has been found in lesser slender salamanders, however the vulnerability of lesser slender salamanders to Bd infection and developing chytridiomycosis is unknown. It is possible that the lesser slender salamander has similar susceptibility to *B. luciae*, which appears to be highly susceptible to wild Bd infection. The USGS tested eight individual lesser slender salamanders collected in 2017 for Bd and found that 2 of the 3 sampled occurrence locations were positive for Bd. Specifically, of the three occurrence locations from which samples were taken, all samples from two of the occurrences (Toro Creek and Santa Rita Creek) were Bd positive, while those from Trout Creek were negative for Bd (R. Fisher pers. Comm. 2018).

Given that (1) Bd is currently found in 2 populations, (2) Bd appears to have been in California since the 1960s, peaked in the 1990s, and decreased since then, and (3) the effects of

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Comment [42]: I would modify to "at least 2 populations"—since most populations not tested

chytridiomycosis can even vary between populations of the same species (Bradley *et al*. 2015, entire), we predict that in the next 25 years, 2 of the 8 occurrence locations will have an associated mass die off and population declines due to Bd under the assumption that the lesser slender salamander has similar susceptibility to *B. luciae*. The extent of the population declines will be dependent on the variation in infection rate and whether there are resistant individuals who are selected for during such a disease event. Disease at a population-level within 2 of the 8 occurrence locations in the next 25 years would decrease the resiliency of those infected lesser slender salamander occurrence locations. If occurrence locations were extirpated due disease, this would decrease the species already limited distribution.

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Comment [43]: typo (the only one I spotted!)

9.6 Summary of Future Threats

We assessed likely change in climate effects and disease 25 years into the future. Projections of climate change along the central coast of California indicate that temperature will increase in the next 25 years. Current effects to the lesser slender salamander from increased temperatures due to climate change include, but are not limited to: reduction of cool areas that supply habitat and reduced survival of all life stages. The species may continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a current population-level effect.

Potential future effects from disease to the lesser slender salamander are unknown. We know that lesser slender salamanders have tested positive for Bd, but we do not know the species' vulnerability to Bd infection and developing chytridiomycosis. Bd appears to have been in California since the 1960s, peaked in the 1990s, and decreased since then. The effects of chytridiomycosis can vary between populations of the same species (Bradley *et al*. 2015). The prevalence of Bd (i.e., number of positives/number sampled) in different populations is likely reflecting the interaction between the host, the pathogen strain, and the environmental conditions they encounter (Spitzen-Van der Sluijs *et al*. 2014; Bacigalupe *et al*. 2017). We forecast the status of the lesser slender salamander after 25 years under two future scenarios, one with continued climate-related effects and disease at the current level, and a second with continued climate-related effects and increased disease susceptibility.

Under Scenario 1 (Climate and Disease Continuation), we found that lesser slender salamanders may be behaviorally flexible to finding locations with the appropriate conditions for breeding, feeding, and sheltering in a changing climate. If current trends in climate continue, the species may continue to be affected by changes in climate on the individual level due to increasing temperatures, but we do not anticipate a population-level effect in the next 25 years. As for potential disease, we determined that the lesser slender salamander may able to stave off a large-scale disease event due to assumed similarity in disease susceptibility to *B. attenuatus*. Given that currently we do not anticipate that disease is a population-level threat to the lesser slender salamander, at this continued level with susceptibility similar to *B. attenuates,* we do not anticipate a population-level effect in the next 25 years.

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Comment [44]: perhaps a matter of emphasis, but if you were to have to put odds on scenario 1 vs. scenario 2, phylogenetic reasoning would say that disease susceptability of B. minor will be more like B. luciae (to which it is much more closely related) than B. attenuatus. If any likelihood is implied by the ordering of scenarios, they should be switched.

Under Scenario 2 (Climate Continuation and Increased Disease), the climate portion is the same as in Scenario 1 and therefore we anticipate that if current trends in climate continue, we do not anticipate a population-level effect in the next 25 years. As for potential increase disease, under

this scenario we assume greater susceptibility to Bd. It is possible that the lesser slender salamander has similar susceptibility to *B. luciae*, which appears to be highly susceptible to wild Bd infection. Based on the USGS findings that 2 of the occurrence locations tested positive for Bd, we assume that approximately 2 of the 8 occurrence locations will have an associated mass die off and population declines due to Bd in the next 25 years. This could decrease the resiliency of those 2 lesser slender salamander occurrence locations. The resiliency of the rest of the occurrence locations would not be affected. If there were extirpations, species representation and redundancy could be reduced.

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Comment [45]: 9

In summary, both of the two future scenarios do not anticipate a population-level effect from changing climate in the next 25 years. Our first future scenario does not anticipate that disease is population-level threat to the lesser slender salamander in the next 25 years; whereas the second future scenario suggests that disease could be a population-level threat to the species, but would not occur rangewide.

10.0 OVERALL SYNTHESIS

Resiliency, Redundancy, and Representation

At this time, we do not have any data to determine the resiliency of lesser slender salamander populations. However, the best available information indicates that the species is extant at all 8 occurrences. These occurrences encompass the north-south and east-west gradients within its limited distribution, maintaining species representation. While redundancy will always be limited for species with limited range, it appears that the redundancy of the lesser salamander is sufficient.

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Comment [46]: see previous comments about this

In the future, we assessed the status of the lesser slender salamander under two scenario 25 years into the future. The first future scenario does not anticipate a population-level effect from changing climate or disease in the next 25 years, suggesting that occurrence location resiliency and species representation and redundancy would remain unchanged. Our second future scenario does not anticipate a population-level effect from changing climate but does anticipate that disease could be a population-level threat to the species, but would not occur rangewide. Where disease occurs the resiliency of those populations would be reduced. If populations were able to recover from declines and no extirpations occurred, species representation and redundancy may remain unchanged. If extirpations occurred, species representation and redundancy could be reduced.

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APPENDIX I. Existing Regulatory Mechanisms

Eight occurrences of the lesser slender salamander have been found at locations along the Santa Lucia Range in San Luis Obispo County, California. From north to south the occurrence locations are referred to as: (1) Las Tablas Ridge, (2) Black Mountain, (3) York Mountain, (4) Santa Rita Creek, (5) Toro Creek, (6) Cerro Alto, (7) Cuesta Ridge, and (8) Trout Creek (S. Sweet pers. comm. 2017.). We define "occurrences locations" as the locality where lesser slender salamanders have been found. Two of the 8 occurrence locations are on U.S. Forest Service Lands (Cerro Alto and Cuesta Ridge: Los Padres National Forest, Santa Lucia Ranger District); the other 6 occurrence locations are on private land, of which, 2 are within the Los Padres National Forest boundary (Toro Creek and Trout Creek).

Federal Mechanisms

All Federal agencies are required to adhere to the National Environmental Policy Act (NEPA) of 1970 (42 U.S.C. 4321 et seq.) for projects they fund, authorize, or carry out. Prior to implementation of such projects with a Federal nexus, the NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural resources. The Council on Environmental Quality's regulations for implementing the NEPA states that agencies shall include a discussion on the environmental impacts of the various project alternatives (including the proposed action), any adverse environmental effects that cannot be avoided, and any irreversible or irretrievable commitments of resources involved (40 CFR part 1502). The public notice provisions of the NEPA provide an opportunity for the Service and other interested parties to review proposed actions and provide recommendations to the implementing agency. The NEPA does not impose substantive environmental obligations on Federal agencies—it merely prohibits an uninformed agency action. However, if an Environmental Impact Statement is prepared for an agency action, the agency must take a "hard look" at the consequences of this action and must consider all potentially significant environmental impacts. Federal agencies may include mitigation measures in the final Environmental Impact Statement as a result of the NEPA process that may help to conserve the Panamint alligator lizard or its habitat.

The Organic Act of 1897 (16 U.S.C. 475–482) established general guidelines for administration of timber on U.S. Forest Service (USFS) lands, which was followed by the Multiple-Use Sustained- Yield Act (MUSY) of 1960 (16 U.S.C. 528–531), which broadened the management of USFS lands to include outdoor recreation, range, watershed, and wildlife and fish purposes.

The National Forest Management Act (NFMA) of 1976 (16 U.S.C. § 1600 et seq.) requires the USFS to develop a planning rule under the principles of the MUSY of 1960 (16 U.S.C. 528–531). The NFMA outlines the process for the development and revision of the land management plans and their guidelines and standards [16 U.S.C. 1604(g)]. A new National Forest System (NFS) land management planning rule (Planning Rule) was adopted by the USFS in 2012 (77 FR 21162; April 9, 2012). The new Planning Rule guides the development, amendment, and revision of land management plans for all units of the NFS to maintain and restore NFS land and water ecosystems while providing for ecosystem services and multiple uses. Land management plans (also called Forest Plans) are designed to: (1) Provide for the sustainability of ecosystems and resources; (2) meet the need for forest restoration and conservation, watershed protection, and

species diversity and conservation; and (3) assist the USFS in providing a sustainable flow of benefits, services, and uses of NFS lands that provide jobs and contribute to the economic and social sustainability of communities (77 FR 21261, April 9, 2012). A land management plan does not authorize projects or activities, but projects and activities must be consistent with the plan (77 FR 21261; April 9, 2012). The plan must provide for the diversity of plant and animal communities, including species-specific plan components in which a determination is made as to whether the plan provides the "ecological conditions necessary to . . . contribute to the recovery of federally listed threatened and endangered species . . ." (77 FR 21265; April 9, 2012).

The Record of Decision for the final Planning Rule was based on the analyses presented in the Final Programmatic Environmental Impact Statement, National Forest System Land Management Planning (77 FR 21162–21276; April 9, 2012), which was prepared in accordance with the requirements of the NEPA. In addition, the NFMA requires land management plans to be developed in accordance with the procedural requirements of the NEPA, with a similar effect as zoning requirements or regulations as these plans control activities on the national forests and are judicially enforceable until properly revised (Wilkinson and Anderson 2002, entire).

Two of the 8 occurrence locations are on U.S. Forest Service Lands (Los Padres National Forest, Santa Lucia Ranger District) and 2 others occurrences are within the Los Padres National Forest boundary. There is no Forest Service management plan in place for the Los Padres that includes amphibian management. There is a forest-wide management plan that outlines general approaches to forest management, and management plans are developed on a project-by-project basis (Cooper pers. comm. 2018).

State Mechanisms

The lesser slender salamander is designated as a California Department of Fish and Wildlife Species of Special Concern (California Department of Fish and Wildlife Natural Diversity Database, 2018). It is the goal and responsibility of the California Department of Fish and Wildlife to maintain viable populations of all native species. To this end, the Department has designated certain vertebrate species as Species of Special Concern because declining population levels, limited ranges, and/or continuing threats have made them vulnerable to extinction. The goal of designating species as "Species of Special Concern" is to halt or reverse their decline by calling attention to their plight and addressing the issues of concern early enough to secure their long term viability. Not all "Species of Special Concern" have declined equally; some species may be just starting to decline, while others may have already reached the point where they meet the criteria for listing as a "Threatened" or "Endangered" species under the State Endangered Species Act. The lesser slender salamander is not listed under the State Endangered Species Act.

California SSCs should be considered during the environmental review process under the California Environmental Quality Act (CEQA; California Public Resources Code §§ 21000-21177). Similar to the Federal NEPA, the CEQA requires State agencies, local governments, and special districts to evaluate and disclose impacts from "projects" in the State. Section 15380 of the CEQA Guidelines indicates that California SSCs should be included in an analysis of project impacts if they can be shown to meet the criteria of sensitivity outlined therein.

References Cited

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Cooper, K. 2018. Phone call from Eric Morrissette to Kevin Cooper, U.S. Forest Service, Los Padres National Forest, Santa Lucia Ranger District. October 25, 2018.

From:	David WAKE
To:	Russell, Daniel
Cc:	Deborah Giglio; Eric Morrissette; Cat Darst
Subject:	[EXTERNAL] Re: Request for Peer Review - Lesser Slender Salamander
Date:	Wednesday, January 9, 2019 8:08:59 PM
Attachments:	Conflict of Interest Disclosure Form_template.pdf Copy of SSA Review Comment Matrix-DW.xlsx Remarks by reviewer David B Wake.docx DBW_CV_Long_with lit_2018.pdf

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Attached please find my review of the Draft Assessment of Lesser Slender Salamanders Batrachoseps minor. For some reason my electronic signature did not "take" so consider it signed. I attach a recent short CV. David Wake

On Thu, Dec 20, 2018 at 12:48 PM Russell, Daniel <daniel_russell@fws.gov> wrote:

> Dear Dr. Wake:
>
> The U.S. Fish and Wildlife Service (Service) is soliciting independent scientific reviews of the information contained in our 2018 draft Species Status Assessment Report for the Lesser Slender Salamander (*Batrachoseps minor*). Once finalized, this Species Status Assessment report (SSA report) will provide the underlying science on which we will base our decision on whether the species warrants listing as endangered or threatened under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.). You were identified by our Ventura Fish and Wildlife Office as a potential peer reviewer based on your area of expertise.
>
> This request is provided in accordance with our July 1, 1994, peer review policy (USFWS 1994, p. 34270) and our current internal guidance. This request also satisfies the peer review requirements of the Office of Management and Budget's "Final Information Quality Bulletin for Peer Review." The purpose of seeking independent peer review of the SSA is to ensure use of the best scientific and commercial information available; to ensure and maximize the quality, objectivity, utility, and integrity of the information upon which we base listing and recovery actions; and to ensure that reviews by recognized experts are incorporated into our final rulemaking processes. Please let us know if you would like us to provide any of the referenced materials to help facilitate your review.
>
> Please note that we are not seeking advice on policy or recommendations on the legal status of the species. Rather, we request that peer reviewers focus their review on identifying and characterizing scientific uncertainties, and on ensuring the accuracy of the biological and land and water use information in the SSA. Specifically, we ask peer reviewers to focus their comments on the following:
>
> (1) Have we assembled and considered the best available scientific and commercial information relevant to this species?
>
> (2) Is our analysis of this information correct?
>
> (3) Are our scientific conclusions reasonable in light of this information?
>
> Our updated peer review guidelines also require that all peer reviewers fill out a conflict of interest form. We will carefully assess any potential conflict of interest or bias using applicable standards issued by the Office of Government Ethics and the prevailing practices of the National Academy of Sciences (http://www.nationalacademies.org/coi/index.html). Divulging a conflict does not invalidate the comments of the reviewer; however, it will allow for transparency to the public regarding the reviewer's possible biases or associations. If we receive comments from a reviewer that we deem to have a substantial conflict of interest, we will evaluate the comments in light of those conflicts, and may choose not to give weight to those comments if the conflict is viewed as problematic. You may return the completed conflict of interest form either prior to or with your peer review.
>
> So that we may fully consider any input and coordinate other peer review comments as we develop the final SSA, and ensure adequate time to complete our 12-month finding, we are requesting peer review comments by January 10, 2019. If you are willing to peer review but are

unable to complete your assessment during this time period, please let me know when we may anticipate receiving your comments. We will summarize and respond to the substantive comments raised by all peer reviewers and use the information, as appropriate, in the final SSA.

While we welcome your peer review comments in any format you are most comfortable using, it would be especially helpful if you could use the attached Comment Matrix Excel spreadsheet. This will make it easier to compile and keep a record of all the comments received and then incorporate them into our report. We would also appreciate receiving a copy of your Curriculum Vitae for our records. Please be aware that your completed review of the SSA, including your name and affiliation, will be included in the administrative record for this evaluation and will be available to interested parties upon request.

If you have any questions about the draft SSA report, or our listing policies in general, please feel free to contact me at any time at (916) 978-6191. Please submit your comments and associated materials to the contact information below, and you may also include the cc: list to this email in your reply.

Thank you very much for your consideration.

Sincerely,
Dan Russell

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Daniel Russell - Regional Listing Coordinator
Pacific Southwest Regional Office, Region 8
U.S. Fish and Wildlife Service
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Sacramento, CA 95825
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David B. Wake
Director, AmphibiaWeb Project
Professor of the Graduate School in Integrative Biology
Curator, Museum of Vertebrate Zoology
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Remarks by reviewer David B. Wake

I first observed this species on February 5, 1960, when the late Arden H. Brame, Jr. and I visited York Mountain Winery and collected 25 specimens that Brame felt represented two different species. We sacrificed, preserved, cleared and stained and observed the 25 specimens and I determined that there were 10 of one kind and 15 of the other, corresponding perfectly to Brame's sorting of the living specimens. This convinced me there were two species. The specimens are preserved in MVZ. Since that time I have observed the species on a number of occasions and have noted the slow but steady decline in abundance of both species (*B. nigriventris* and *B. minor*), but especially of *B. minor,* which in my experience has become difficult to predictably observe.

As is recognized in the draft, I was a coauthor of the formal description of the the species *Batrachoseps minor*.

I have studied the draft report. In my opinion it is competently done. The species is so poorly known that there is of necessity a lot of speculation. But I think in general it is a fine report.

My primary concern is that there is an over-emphasis on the potential negative effects of climate change and disease and an underemphasis on habitat modification. I think the habitat has deteriorated severely since the 1960s, mainly by clearing and cleaning brush and by the invasion of exotic vegetation.

A bit unknown is Bd, which might have played a role in the general decline of abundance in California salamanders, which is evident to all experienced field biologists who have 50 or more years of experience. We simply do not know.

I am impressed that Sam Sweet has found the species at all historic localities and some new ones. I have been unable to do so, and my observations are most extensive for just two sites – the York Mt Winery are and the Santa Rita-Old Creek Road region. In both areas I have detected considerable habitat degredation since the 1960s.

Response to questions:

(1) Have we assembled and considered the best available scientific and commercial information relevant to this species? Yes

(2) Is our analysis of this information correct? I think the effects of climate change and disease or overemphasized.

(3) Are our scientific conclusions reasonable in light of this information? In general, yes, with the caveats noted.