Desert slender salamander
(Batrachoseps major aridus)

5-Year Review:
Summary and Evaluation

Photo from Carlsbad Fish and Wildlife Office files

U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
Carlsbad, California

June 17, 2009

5-YEAR REVIEW
Desert Slender Salamander (*Batrachoseps major aridus*)

I. GENERAL INFORMATION

A. Methodology used to complete the review:

Tyler Grant, Fish and Wildlife Biologist of the Carlsbad Fish and Wildlife Office, U.S. Fish and Wildlife Service (Service) compiled this review. Internal documents and files, public documents, published scientific literature, and expert opinion were used to conduct this review.

B. Reviewers

Lead Region: Diane Elam, Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning, and Jenness McBride, Fish and Wildlife Biologist, Region 8; 916–414–6464.

Lead Field Office: Tyler Grant and Bradd Baskerville-Bridges, Carlsbad Fish and Wildlife Service; 760–431–9440.

C. Background

1. FR Notice citation announcing initiation of this review: 72 FR 7064, February 14, 2007. We received no information from the public in response to our request in the notice.

2. Listing history:

Original Listing

FR notice: 38 FR 14678
Date listed: June 4, 1973
Entity listed: Animal species (see section d below for recommended change to subspecies status)
Classification: Endangered

3. Associated actions: None. It was deemed imprudent to designate critical habitat, because public knowledge of the exact location of the desert slender salamander could attract unscrupulous collectors or other visitors that could cause potential harm to the habitat.

4. Review History: None.

5. Species' Recovery Priority Number at start of review: This animal was given a recovery priority number 8, indicating that the species faced a moderate degree of threat and high potential for recovery, based on a 1–18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983).

6. Recovery Plan or Outline

Name of plan: Desert Slender Salamander
Date issued: August 12, 1982
Dates of previous revisions: none

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy:

1. Is the species under review listed as a DPS?

No.

2. Is there relevant new information that would lead you to re-consider the classification of this species with regard to designation of DPSs (i.e., indicates that there was a problem with the original (post-1996) DPS listing, that there is a need for splitting out or combining DPSs, or that there is some other reason to consider a change in listing that involves DPSs)?

No.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan?

Yes.

2. Does the recovery plan contain recovery (i.e., downlisting or delisting) criteria?

The recovery plan does not contain formal recovery criteria. Goals and other objectives of the recovery plan are discussed below.

3. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available (i.e., most up-to-date) information on the biology of the species and its habitat?

No. The species has not been detected at Hidden Palm Canyon since 1996 and may be extinct there. Most of the habitat in Hidden Palm Canyon has been washed away by storms. At the time the recovery plan was written, it was not known if the Guadalupe Canyon population was

the same species or not. It was later determined to be the same species, at least based on appearance.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and there is no new information to consider regarding existing or new threats)?

No, the 5 listing factors are not addressed in the recovery criteria.

4. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5-listing factors are not relevant to this species, please note that here.

The recovery plan provides a step-down outline to prevent the extinction of the desert slender salamander. These are not formal recovery criteria and are not explicitly related to the five listing factors; however, these actions would benefit the conservation of this species by helping to reduce or eliminate threats addressed by the listing factors. The categories are broadly discussed below:

1. Protect and manage the Hidden Palm Ecological Reserve.

   The Hidden Palm Ecological Reserve was established in 1974 by the California Department of Fish and Game (CDFG) in Riverside County and has since been closed to the public. Over time, management of the Reserve for the desert slender salamander has decreased as interest and management options have waned. Gabions that were installed in the late 1970s to attempt to prevent more erosion are still present. The reserve management committee that was originally formed hasn't met since the mid-1980s. Monitoring of the population and habitat has not consisted of any more than periodic visits by CDFG biologists. Recent management has focused on clearing vegetation to create a safe watering hole for bighorn sheep.

2. Develop and implement plans for other naturally occurring populations of the desert slender salamander.

   The Guadalupe Canyon site occurs in the Santa Rosa and San Jacinto Mountains National Monument that is owned and managed by the Bureau of Land Management (BLM). The Management Plan for this area (BLM 2003; pp. 2-7, 2-8, 4-14) discusses the desert slender salamander, but mandates no specific actions for this species beyond vague "monitoring." Guadalupe Canyon is in a designated wilderness area. No other populations have been verified. There may still be some populations at remote seeps or springs.

3. Assess feasibility and necessity of introducing the desert slender salamander at particular sites.

   No specific experiments have been conducted on the feasibility of relocating desert slender salamanders to a new locality. No *Batrachoseps* species have ever been successfully bred in captivity.
4. Minimize unauthorized disturbance to the desert slender salamander and its habitat.

   Because the Hidden Palm Ecological Reserve is closed to the public, disturbance is minimized. A road pullout on Highway 74 was relocated to discourage access to the reserve. The wilderness designation of the Guadalupe Canyon site also minimizes disturbance.
5. Determine the number and sizes of populations necessary for reclassifying the species to threatened and to delist.

   A few studies have attempted to roughly estimate population sizes, but it is difficult to study a species that spends most of its time below the surface without damaging the habitat.

More specific recovery criteria would greatly aid this species. To downlist to threatened, several actions or objectives similar to criteria are suggested in the recovery plan:

1. Identify at least two populations and ensure they will remain self-sustaining in the long-term.
   a. If one of those populations is at the Hidden Palm Canyon site, evaluate the long-term sustainability of the water source for the spring and ensure that it will remain stable and sufficient for the salamanders needs. Also evaluate if hydrology can be modified so that storm flows are not so violent.
   b. Verify that the Guadalupe Canyon population still is distributed as before.
   c. Make more efforts to locate other populations of desert slender salamanders.
2. "Restore" the Hidden Palm Canyon habitat. It might be as simple as installing some posts and stringing chicken-wire or a finer fence material between posts to hold some material up against the wet side of the canyon. The material held up by the posts could be a mixture of gravel/cobble and organic material (e.g., leaves). The rock would create a matrix with lots of internal spaces for salamanders to live and hide and the organic material would hold moisture and grow insect food. Such structures would have to be periodically repaired after storm events if the hydrology was not modified.

C. Updated Information and Current Species Status

Biology and Habitat

a. Species overview

The desert slender salamander is a small, subterranean amphibian. Adults are approximately 4 inches in total length, with a tail of approximately 2 inches and body of approximately 2 inches. The original description described the color as blackish maroon with a suffusion of shiny flecks on the upperside. It is a member of the family Plethodontidae, the largest family of salamanders, which are lungless. Because of their small size and moist skin they are able to obtain all the oxygen they need through their skin. Consequently, they must remain in a moist environment, which has constrained the desert slender salamander to perennial seeps and springs on the desert slopes of the Santa Rosa Mountains in Riverside County, California. In these areas it lives in moist subterranean spaces such as crevices, cracks, and other animal burrows, even earthworm burrows. The talus rock piles on top of seeps where it was first found formed the perfect habitat of dark moist interconnected spaces. To what depth they may descend is unknown, but they likely descend several feet below the surface. Like other related species, they probably lay eggs deep underground. At hatch, young likely develop directly into miniature versions of adults, as in other *Batrachoseps* species, bypassing the larval stage that most amphibians exhibit. Adults and juveniles feed on the myriad of small arthropods to be found in moist, dark places, using a special projectile tongue typical of closely related plethodontids to catch prey.

b. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate), or demographic trends:

A study in 1977–1978 was the last detailed study of the Hidden Palm Canyon population (Bleich 1978). Surveys were conducted four times per month from March 1977 to March 1978, typically during the night. A relative abundance index of the number of salamanders found per unit of search time was calculated. Typically 0 to 10 salamanders were found per 100 minutes (Bleich 1978, Tables 1–13). The most salamanders found in one night was 21 (Bleich 1978, p. 9). Bleich (1978, p. 9) used numbers from another study (Cunningham 1960) where it was estimated that 4.0 to 11.5 percent of garden slender salamanders, the desert slender salamander's sister subspecies, were on the surface at any one time. Bleich thus estimated a range of 133 to 515 salamanders in Hidden Palm Canyon. It is not known what percentage of desert slender salamanders are usually active on the surface, thus the accuracy of this estimate is suspect, but it presents a general idea. A total of 343 salamander sightings were made over the course of the study (Bleich 1978, p. 16). Based on length, a large proportion of the salamanders detected during most months of the year were

juveniles, indicating a reproducing population (Bleich 1978, p. 8). CDFG has periodically (usually every year) checked to see if they could still find salamanders at the Hidden Palm Canyon site. These checks were typically casual searches when CDFG biologists were in the vicinity clearing the watering hole for bighorn sheep. Salamanders have not been found in the last 10 years. The last one seen was in 1996 by a CDFG biologist (Eddy Konno, CDFG, pers. comm., 2006). While these casual searches are certainly not substantive enough to conclude that the species is extirpated at the site, it is also true that the salamanders were easily found by such searches before the habitat changed (see below). Three biologists, one each from USFWS, CDFG, and BLM, visited the site in November of 2006 and were unable to find any salamanders. However, the nature of the habitat is now such that anything but a cursory surface search is not appropriate because it would require too much damage of the habitat. The exact location in the canyon where the salamanders were last seen is a nearly vertical wall of ferns. The soil rooting these ferns is essentially held in place by the ferns and other vegetation and would easily erode if disturbed too much. A more comprehensive search would involve night searches with flashlights, perhaps after a light rain in late fall or early spring.

No information on abundance has been collected on the Guadalupe Canyon population since the first study in 1984–1985 (Duncan and Esque 1986). In that study they saw a total of 30 salamanders over 15 nights of sampling (Duncan and Esque 1986, p. 6, p. 22). The low detectability of this species suggests that there were many more than 30 salamanders.

c. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding):

No information is known on genetic variability in this species. If the Hidden Palm population is extant, it may be experiencing a bottleneck due to small population size that has implications for future genetic viability.

d. Taxonomic classification or changes in nomenclature:

The desert slender salamander was described as *Batrachoseps aridus* (Brame 1970) and listed as such in 1973 (USFWS 1973, 38 FR 14678).

Genetic analysis and morphological assessments of specimens collected from one of the two known occurrences indicate that the taxon is better treated as a subspecies of *Batrachoseps major*, the garden slender salamander (Wake and Jockusch 2000, pp. 105–110). This recommendation has been accepted by herpetological societies and the latest list of official common and scientific names for amphibians and reptiles north of Mexico (Crother 2008).

Currently the desert slender salamander is listed in the Code of Federal Regulations at 50 CFR 17.11 as a species, *Batrachoseps aridus.* As part of the completion of this 5-year review the Carlsbad Fish and Wildlife Office will

submit a recommendation that 50 CFR 17.11 be amended to indicate that the desert slender salamander is recognized as *Batrachoseps major aridus*, a subspecies. Recognition at the rank of subspecies does not alter the description or range of the listed entity.

The desert slender salamander will be referred to in this document as *Batrachoseps major aridus* and any recommended changes to the recovery priority number will be made accordingly.

e. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors), or historical range (e.g., corrections to the historical range, change in distribution of the species' within its historical range):

The desert slender salamander was originally known only from the Hidden Palm Canyon site. In 1980–1981, 34 sites that could have harbored other populations of desert slender salamander were surveyed (Giuliani 1981). A new population of *Batrachoseps* was found in Guadalupe Canyon, approximately 4.5 miles from the Hidden Palm Canyon site (Giuliani 1981, p. 3). It was not certain at first that the Guadalupe Canyon population was desert slender salamander. Arden Brame, who described the animal, examined an individual from Guadalupe Canyon and concluded that it was *B. aridus* (Brame, pers. comm. 1981). Wake and Jockusch (2000, p. 102) treated the two populations (Guadalupe Canyon and Hidden Palm Canyon) as the same taxon.

Duncan and Esque (1986, p. 30) recommended that Martinez Canyon and the South Fork of Martinez Canyon, and Black Rabbit Canyon, which all have permanent water sources, be surveyed at the appropriate time of year for possible unknown populations of desert slender salamander.

Two salamanders were seen at Limestone Springs in Anza-Borrego Desert State Park in 1982 or 1983 (Bolster, *in litt.* 1995, CDFG, *in litt.* 1984). They were found after the location was improved as a watering hole for bighorn sheep. It was thought that they might be *Batrachoseps aridus* because of their location in the southern Santa Rosa Mountains; however, it is also possible that they were *B. major* because the location is somewhat near the eastern extent of the known range of *B. major*. No further salamanders have been found, although survey efforts have been cursory. Limestone Springs seems unsuitable for salamanders because there was no surface water before it was developed as a watering hole; thus, the presence of salamanders at this location is unusual.

f. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

This species requires underground retreats where they can remain moist, lay eggs, and avoid predators. Broken limestone sheets and honeycombed limestone were the primary habitat for this species at Hidden Palm Canyon. However, it was recognized after listing that the habitat for this species at the

Hidden Palm site was in danger of erosion during storms. After a 1976 storm washed out an estimated 25 percent of the habitat, CDFG established some gabions in December 1977 (USFWS 1982, p. 13). The limestone sheets and talus where the salamanders were first discovered and most commonly found were completely eroded away. The canyon floor at the site was eroded down 6 to 10 feet (USFWS 1982). Bleich (1978) studied the remaining habitat after the storm of 1976 and found an area where she could consistently find salamanders. However, despite the gabions, later storms also eroded the habitat where Bleich (1978) found salamanders. Thus the habitat where the species was most often found in the greatest numbers is now gone. The most recent sighting in 1996 was by a CDFG biologist in a nearly-vertical bank of ferns (Eddy Konno, CDFG, pers. comm. 2006). The gabion is still largely intact and likely has aided in reducing further erosion of the steep canyon-side; however, there is much less habitat remaining than when the species was listed.

Tamarisk was noted as present by Duncan and Esque (1986, p. 48) in 1984 in Guadalupe Canyon. This invasive species can deplete ground water and thus decrease surface water. There is less potential for this to occur in Guadalupe Canyon, compared to less rocky, flatter areas; however, the current water level in Guadalupe Canyon should be compared to measurements reported by Duncan and Esque (1986).

3. Five Factor Analysis

The 1973 listing rule (38 FR 14678) did not contain a five-factor analysis that identified the threats to the desert slender salamander. Our 1982 recovery plan (USFWS 1982) described the general threats affecting this species.

a. Present or threatened destruction, modification or curtailment of its habitat or range:

The threats to desert slender salamander habitat described in the 1982 recovery plan included human disturbance or destruction of the habitat. In 1973, 134.5 acres of land surrounding and including the Hidden Palm Canyon site was purchased by CDFG. This land was established as the Hidden Palm Ecological Reserve in 1974. A management plan was finalized in 1975 (CDFG 1975) that allows entrance only by permit. A pullout along Highway 74 near the site was removed. Consequently, much of the threat of human disturbance has gone largely unrealized over the years since the species was listed, though the proximity to highway 74 continues to require vigilance. The remote nature of the Guadalupe Canyon site limits human use, but also limits evaluation of how much use is occurring. The habitat is not as fragile in Guadalupe Canyon and the threat of human inadvertent damage is far less.

The recovery plan also identified the threat of erosion of habitat at the Hidden Palm Canyon site, particularly by large storms. Habitat (talus, limestone sheets, limestone honeycomb) where salamanders were previously found has eroded away. A gabion structure attempted to stem some of the erosion and has

probably been partially successful, but habitat has continued to erode over time. This threat still exists because of the nature of the site. Without seeing the site, it is difficult to understand the potential violence of large storm events. The location of where the salamanders occur is below a large cliff-like drop in the wash. Desert flash floods with their associated sediment would violently scour the bottom of the wash. The sides of the canyon are extremely steep, cliff-like in many places, and accessing the site is difficult. The site is subject to scouring floods, as evidenced by the nearly complete lack of tamarisk plants in 2006, which had been known to occur at the site.

Fires have increased in deserts in recent decades as non-native grasses have increased in biomass. A fire on the slopes surrounding Hidden Palms Canyon or in the watershed above could cause transport of massive amounts of sediment through the site, exacerbating erosion.

The recovery plan also identified the threat of watershed ground pumping. Ground water pumping by development uphill from Hidden Palm Canyon may decrease the water flow to the seep. If the water flow were to decrease enough, it would become too dry for the species and it would become extirpated at that location. Some early planning was developed to monitor groundwater levels in the drainage, but these were apparently never carried out. Water is still present at the site, but quantitative measures of whether it is decreasing or remaining stable have not been taken. Groundwater level measurements are not available from the watershed. Some further development of residences has occurred in the watershed above the site.

It may be that the hydrology of the area was modified by construction of Highway 74, which is in the small watershed that drains into Hidden Palm Canyon. Modification of the hydrology may have resulted in more violent flows or more erosive, sediment-laden flows, which have eroded salamander habitat. Substantial down-cutting, several feet in some places, is apparent in the washes entering Hidden Palm Canyon. The effect is subtle, but the deep downcutting present in washes flowing into Hidden Palms Canyon may indicate that more sediment is being flushed through.

Climate change could increase evaporation and decrease the amount of moist habitat available for slender salamanders. Tamarisk may be a threat to the Guadalupe Canyon population. Otherwise, the Guadalupe Canyon site is fairly secure.

b. Overutilization for commercial, recreational, scientific, or educational purposes:

Overutilization for scientific purposes was identified as a potential threat in the recovery plan. Six individuals were sacrificed from the Guadalupe Canyon population in 1983 for genetic evaluation; these animals were sacrificed without authorization from the Service. New methods should allow non-lethal collection of DNA specimens from the salamanders, which can then be returned to their habitat. Sampling this species for any studies must be very judicious. Currently we are aware of no collecting of this species. At this time, no collecting should be

allowed of the Hidden Palm Canyon population. While collection of this species for black market sale as a pet is a possibility, it is a very small one. The exact location of habitat has consequently not been made widely available. We are aware of no other utilization of this species for commercial, recreational, or educational purposes.

c. Disease or predation:

Disease was not described as a threat in the 1982 recovery plan. However, since 1982, the amphibian disease chytridiomycosis, caused by the chytrid fungus *Batrachochytrium dendrobatidis*, has caused alarming declines in anuran (frog) populations worldwide (Lannoo 2005). The potential occurrence and effect of this fungus on salamander populations is poorly known, but salamanders can become infected (Davidson et al. 2003, p. 1) and chytridimycosis has been implicated in salamander declines elsewhere (Bosch and Martinez-Solano 2006, p. 1). This disease could devastate the small population(s) of desert slender salamanders. Surveys for this species could introduce this pathogen through infected clothing (muddy boots) or equipment if proper precautions are not implemented. Prohibited public access to the reserve helps to minimize the threat from this disease.

Predation was not identified as a threat in the recovery plan. No instances of predation have been observed. Nearly any bird or reptile would likely depredate this species if presented the opportunity, but no data are available to determine if predation is significant to population dynamics in this species.

d. Inadequacy of existing regulatory mechanisms:

Regulatory mechanisms are currently adequate for this species. Hidden Palm Canyon is protected as a CDFG Reserve. Signs are posted to inform potential trespassers that the reserve is closed to the public. However, these signs are posted out of sight of the nearest roads, so that no attention is attracted to the site. The Guadalupe Canyon site is in a designated Wilderness Area.

e. Other natural or manmade factors affecting its continued existence:

The recovery plan identified the small size of the population as a threat. Chance events outside the range of natural variability can substantially reduce or eliminate small populations and increase the likelihood of extinction (Lande 1993). Small populations are more vulnerable to natural catastrophes and stochastic demographic, genetic, and environmental events. Aspects of the conservation biology literature commonly note the vulnerability of taxa known from one or very few locations and/or from small populations, and the adverse demographic and genetic effects of declining populations (Caughley 1994, Groom et al. 2006, Lande 1987). In particular, small population size increases the risk of the desert slender salamander to many of the above mentioned threats (e.g., disease, erosion).

Climate change also has the potential to adversely affect this species and its habitat. Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, Cayan et al. 2005, IPCC 2007). However, predictions of climatic conditions for smaller sub-regions such as California remain uncertain. It is unknown at this time if climate change in California will result in a warmer trend with localized drying, higher precipitation events, or other effects. While we recognize that climate change is an important issue with potential effects to listed species and their habitats, we lack adequate information to make accurate predictions regarding its effects to particular species at this time.

D. Synthesis

The first known population of this species in Hidden Palm Canyon cannot be found and its status is difficult to evaluate. It may be extinct or may be surviving in habitat that is difficult to survey. The other known population, in Guadalupe Canyon, is restricted to a very small area and its status is unknown, having not been surveyed since 1985. Threats identified in the 1982 recovery plan have not substantially changed, and include erosion of habitat, small population size, and groundwater pumping. Of these, small population size and groundwater pumping are still major threats. Climate change and chytridiomycosis are new threats identified since listing. We conclude that the desert slender salamander still meets the Endangered Species Act's definition of endangered given the threats to the species, in particular small population size and the risk of extinction from random catastrophic events, chytrid fungus, climate change, possibly depletion of ground water by tamarisk, and small geographic area inhabited by this species. We recommend that the current status of the desert slender salamander remain unchanged, as endangered.

III. RESULTS

A. Recommended Classification:

____ Yes, downlist to threatened
____ Yes, uplist to endangered
____ Yes, delist
__X_ No change is needed

B. New Recovery Priority Number _12__

We recommend a new recovery priority number of 12, indicating moderate threat (primarily natural threats) and low potential for recovery for this subspecies (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). We indicate moderate threat because the species is very rare and habitat continues to be threatened with erosion at Hidden

Palms Canyon. We indicate low recovery potential because habitat is very limited and restoration or creation of habitat may require intensive management and may not be successful.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

Information on the current status of both populations is needed. We recommend the following:

1. Survey Hidden Palm Canyon to determine the status of the population there.

2. Survey Guadalupe Canyon to gain information on the status of that population. Repeat measurements made by Duncan and Esque (1986) to determine changes in habitat suitability. Determine if tamarisk is present in substantial numbers and remove if necessary.

3. If a population remains at Hidden Palm Canyon, evaluate options for habitat restoration. Monitor groundwater levels in the drainage.

4. Survey other potentially suitable sites for unknown populations.

V. REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-Year Review of *Batrachoseps major aridus*

Current Classification __Endangered__

Recommendation resulting from the 5-Year Review

____ **Downlist to Threatened**
____ **Uplist to Endangered**
____ **Delist**
__X__ **No change is needed**

Review Conducted By __Tyler Grant__

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date June 17, 2009