RELICTUAL SLENDER SALAMANDER

Batrachoseps relictus Brame and Murray 1968

Status Summary

Batrachoseps relictus is a Priority 1 Species of Special Concern, receiving a Total Score/Total Possible of 60% (66/110). It was also considered a Species of Special Concern during the previous evaluation (Jennings and Hayes 1994a); however, the range of the species has since been greatly reduced as a consequence of taxonomic revisions.

Identification

As is typical of its genus, *Batrachoseps relictus* is a small, elongate, worm-like salamander with a slender body, long tail, and tiny limbs. The dorsal coloration is blackish brown with a lighter, often indistinct dorsal stripe that may be reddish, yellowish, or dark brown (Stebbins 2003). *Batrachoseps relictus* is one of the smallest members of its genus. SVLs of mature animals collected at the type locality in the lower Kern River Canyon (see the "Distribution" section) averaged 30.2 mm, while those from Breckenridge Mountain averaged somewhat larger at 39 mm SVL (Jockusch et al. 2012). *Batrachoseps relictus* also has relatively few trunk vertebrae, with a modal number of 17 from the type locality (Brame and Murray 1968) and counts as low as 17 occurring with low frequency in the

Relictual Slender Salamander: Risk Factors

Ranking Criteria (Maximum Score)	Score
i. Range size (10)	10
ii. Distribution trend (25)	10
iii. Population concentration/ migration (10)	0
iv. Endemism (10)	10
v. Ecological tolerance (10)	7
vi. Population trend (25)	15
vii. Vulnerability to climate change (10)	7
viii. Projected impacts (10)	7
Total Score	66
Total Possible	110
Total Score/Total Possible	0.60

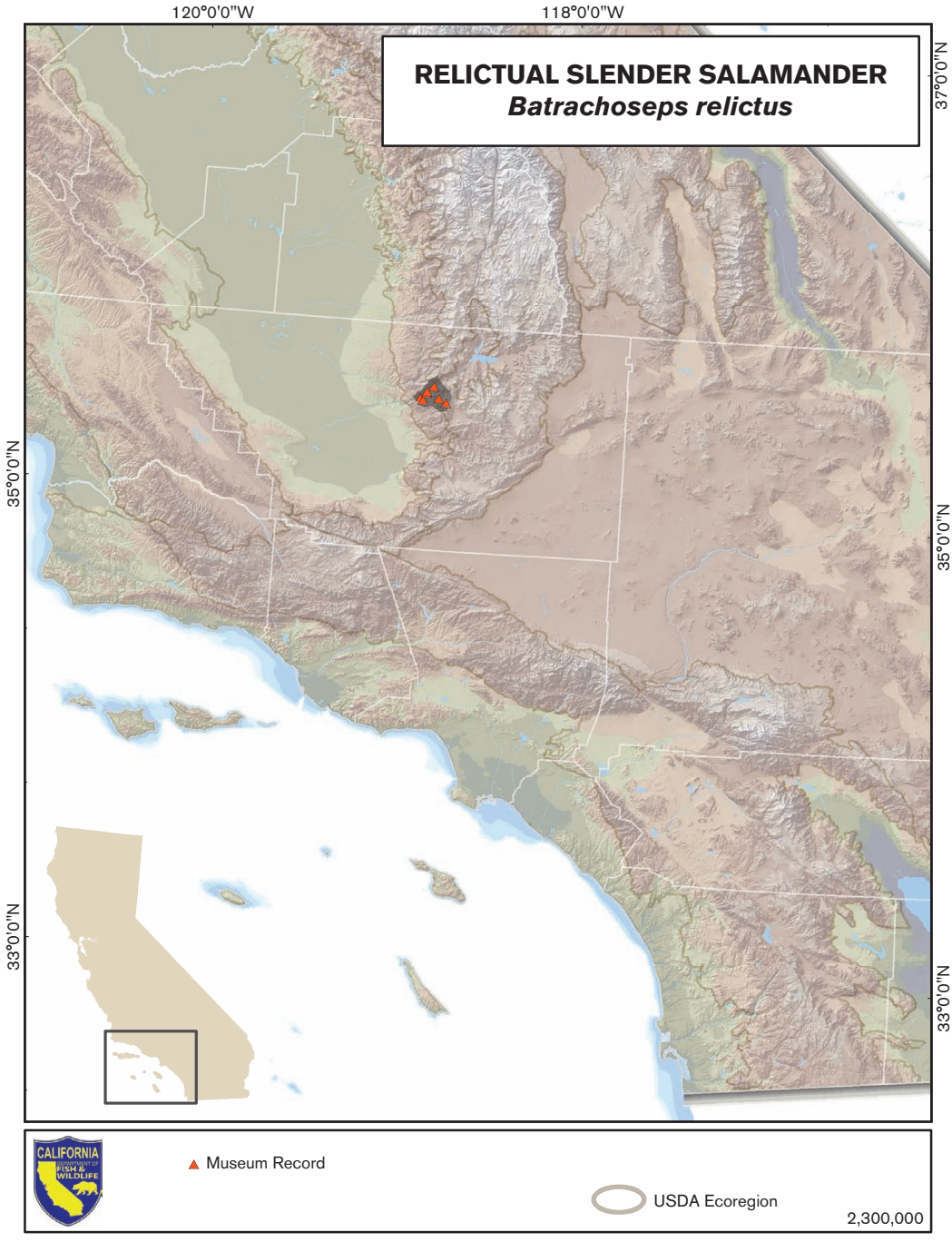

PHOTO ON PREVIOUS PAGE: Relictual slender salamander, Kern County, California. Courtesy of William Flaxington.

Breckenridge Mountain populations (Jockusch et al. 2012).

Several other species of *Batrachoseps* occur in the same region of the southern Sierra Nevada, and geographic range is the best way to distinguish animals in the field. Individuals from the upper Kern River Canyon (Greenhorn Mountains slender salamanders, *B. altasierrae*) that were previously considered a part of *B. relictus* (see the "Taxonomic Relationships" section) have relatively longer trunks, smaller heads, shorter limbs, and smaller feet (Jockusch et al. 2012). Female *B. altasierrae* have fewer maxillary teeth, and the vomerine teeth in both sexes are patchily distributed, compared to being arranged in rows in *B. relictus* (Jockusch et al. 2012).

In the lower Kern River Canyon, the range of *B. relictus* overlaps with Kern Canyon slender salamanders (*B. simatus*) and the yellow-blotched ensatina (*Ensatina eschscholtzii croceator*; Brame and Murray 1968). Unlike *B. relictus*, *B. simatus* is not closely associated with water, and populations of *B. relictus* at elevations where *B. simatus* occurs are likely extirpated (see the "Distribution" section). *Ensatina eschscholtzii croceator* is a larger, more robust salamander and is easily distinguished by conspicuous yellow blotches on the dorsum and a much larger body form (Stebbins 2003).

Taxonomic Relationships

The populations included in *Batrachoseps relictus* have changed considerably since its original description. Brame and Murray (1968) considered several geographically disjunct populations as belonging to *B. relictus*, most of which are now recognized as distinct species (Yanev 1978, Yanev 1980, Jockusch et al. 1998, Wake and Jockusch 2000, Jockusch et al. 2001). Populations in the Sierra Nevada from the Merced River to the Kern River were considered a part of the *relictus* group (Yanev 1980) and were split into four allopatric species by Jockusch et al. (1998). At that time, *B. relictus* was thought to range from the Tule River drainage to the lower Kern River Canyon, including populations in the Greenhorn Mountains (Jockusch et al. 1998, Jockusch and Wake 2002). Since then, populations from the upper Kern River have been found to be morphologically distinct from salamanders at the *B. relictus* type locality, and have been described as the new species *B. altasierrae*, the Greenhorn Mountains slender salamander. (Jockusch et al. 2012). Populations of *Batrachoseps* on Breckenridge Mountain were discovered in 1979. Jennings and Hayes (1994a) designated this putative taxon as a Species of Special Concern. Recent morphometric analyses have shown that populations from Breckenridge Mountain are most similar to *B. relictus* from the type locality, and are now included as *B. relictus* (Jockusch et al. 2012). Given the description of the new taxon *B. altasierrae*, the classification of Breckenridge Mountain populations as *B. relictus*, and the presumed extirpation of the type locality (see the "Distribution" section), extant *B. relictus* only occur on Breckenridge Mountain under the current taxonomic arrangement.

While we follow the recommendations of Jockusch et al. (2012) to recognize *Batrachoseps* from Breckenridge Mountain as *B. relictus*, it is important to note that their phylogenetic analyses of mitochondrial DNA show these populations as nested within *B. simatus*, the Kern Canyon slender salamander. Jockusch et al. (2012) argued that allozyme data and unpublished nuclear data recovered a different pattern that corroborated the distinctiveness of *B. relictus*, and that the mitochondrial DNA results were potentially explained by introgression from *B. simatus* into *B. relictus*. This interpretation appears to be reasonable. However, given the complexity of this group, it remains possible that additional work may lead to further taxonomic revisions.

Life History

Very little is known about the natural history of *Batrachoseps relictus*, and much of the ecological literature published under this name refers to what is now classified as *B. altasierrae*. *Batrachoseps relictus* on Breckenridge Mountain (1700–2000 m elevation) have been found surface active under cover objects from May to early

October (Jockusch et al. 2012). At lower elevations in the Kern River Canyon, animals have been collected between January and May, suggesting that surface activity is possible over most of the year and varies with elevation. Association with aquatic microhabitats likely facilitates extended periods of surface activity (see the "Habitat Requirements" section). Like other plethodontid salamanders, *B. relictus* is a direct developer that lays terrestrial eggs. Females have been found with yolked ova or eggs in May and June (Jockusch et al. 2012). A communal nest with roughly 125 eggs and 20 adults was discovered beneath a rock in a seep during June 1979 at the high-elevation site on Breckenridge Mountain (R. Hansen, pers. obs., in Jockusch et al. 2012; observation incorrectly ascribed to *B. simatus* in Stebbins 1985). Diet has not been studied in *B. relictus*. Presumably they use their projectile tongues to catch small invertebrates, as do other *Batrachoseps* species (Hansen and Wake 2005c).

Habitat Requirements

Individuals from the type locality in the lower Kern River Canyon have been found associated with perennial springs, seeps, and small creeks in oak woodland below 750 m (Hilton 1948, Brame and Murray 1968). This close association with water was described as "semiaquatic" by Brame and Murray (1968). Animals have been found under cover objects with water beneath them and observed in the water (Hilton 1948, Jockusch et al. 2012). On Breckenridge Mountain the dominant vegetation type at extant localities is pine–fir forest (Jockusch et al. 2012). East of Squirrel Meadow at 2000 m elevation, *Batrachoseps relictus* is typically associated with a small seep and sandy or gravel substrate (Jockusch et al. 2012). Use of upland habitat away from water is unknown, but two adults were found 45 m upslope from seep habitat at the Squirrel Meadow site (Jockusch et al. 2012). At Lucas Creek, the lower-elevation extant locality on Breckenridge Mountain (1665 m), all *B. relictus* to date have been found under cover objects along a 750 m stretch of stream (Jockusch et al. 2012).

Distribution (Past and Present)

The type locality is in the lower Kern River Canyon, 150 yards above the junction of state Highway 178 and the road turnoff to Democrat Hot Springs and Resort (Brame and Murray 1968). Despite repeated, careful searches, *Batrachoseps relictus* have not been seen at the type locality since 1970 (Jockusch et al. 2012; incorrectly reported as 1971 elsewhere). Extirpation of the type locality may have been caused by the degradation of the sensitive seep and spring habitat due to the construction of Highway 178 (Hansen 1988). With the presumed extirpation of the type locality, *B. relictus* is now thought to be restricted to two localities on Breckenridge Mountain, and has the smallest known range for any described species of *Batrachoseps*. Populations north of the Kern River including the Greenhorn Mountains are no longer considered a part of *B. relictus* (see the "Taxonomic Relationships" section). The known elevation range is from 480 m in the Lower Kern Canyon River up to 2000 m on Breckenridge Mountain (Jockusch et al. 2012).

Trends in Abundance

Declines are suspected at one extant site, the area east of Squirrel Meadow on Breckenridge Mountain. The locality was first discovered in 1979 but later degraded by construction of a logging road through *Batrachoseps relictus* habitat. Salamanders were not seen at this site for two decades, with declines presumed to be due to habitat degradation from road construction, wildfire, and timber harvest (Jockusch et al. 2012). More recent surveys of the site have found that populations appear to be rebounding to some degree (Jockusch et al. 2012). Whether such variation in abundance over time is typical, due to detection difficulty, or actual anthropogenic declines is unknown.

Nature and Degree of Threat

The major threat to *Batrachoseps relictus* is habitat degradation, particularly of sensitive spring and seep habitat. Climate change is expected to increase temperatures in the Sierra Nevada,

although changes in precipitation and fire regime are highly uncertain and large regional variation is expected across the mountain chain and at different elevations (reviewed in PRBO 2011). If conditions become warmer and drier, this would presumably negatively affect *B. relictus* populations, although microhabitat characteristics are likely key to determining surface activity and population stability. Large reductions in snowpack are predicted for the Sierra Nevada (reviewed in PRBO 2011), which may decrease the availability of streamside habitat for *B. relictus*.

Status Determination

The extremely limited geographic range of *Batrachoseps relictus*, the small number of known extant populations, and apparent extirpation of the type locality contribute to a Priority 1 Species of Special Concern designation for the species.

Management Recommendations

Protecting the two remaining localities from habitat degradation is critical to the persistence of *Batrachoseps relictus*. Given the extremely sensitive and restricted range of the species, any habitat modification should be avoided where the species still occurs. Road construction should be avoided, and road use and maintenance activities should be restricted, or ideally eliminated altogether. Timber harvest and use of heavy equipment in or near seeps and streams should be eliminated. If the type locality is confirmed to be extirpated, then repatriation of the species to the type locality may be appropriate. However, the lack of genetic information from this site (no genetic samples exist) and the overall state of flux in the classification of southern Sierra Nevada *Batrachoseps* may argue against such reintroductions pending further molecular systematics work on the group as a whole. Although the extent and use of upland habitat is unknown, protection of riparian buffers would almost certainly benefit this species in disturbed areas. In addition, it is probably reasonable to assume that livestock grazing should be eliminated from areas where the species still occurs, at least until field ecological studies indicate that grazing is compatible with the salamander's habitat requirements.

Monitoring, Research, and Survey Needs

Basic life history and population biology information is severely lacking for this species, and represents a critical research need. A key survey need is to attempt to locate additional populations, particularly at mid-elevations on Breckenridge Mountain, which are largely unexplored (Jockusch et al. 2012). High-priority sites for surveys include streamside and seep habitats on the north face of the mountain. Monitoring should continue at the lower Kern River Canyon localities to confirm extirpation. Populations at the higher-elevation Breckenridge Mountain locality went undetected for many years, and it remains possible that animals could be rediscovered at the type locality. If so, the collection of genetic samples would be invaluable to support or refine the current taxonomy of the species, and to help determine patterns of connectivity among remaining populations.