

Correction of Locality Records for the Endangered Arroyo Toad (*Anaxyrus californicus*) from the Desert Region of Southern California

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Abstract.—The recovery strategy for an endangered species requires accurate knowledge of its distribution and geographic range. Although the best available information is used when developing a recovery plan, uncertainty often remains in regard to a species actual geographic extent. The arroyo toad (*Anaxyrus californicus*) occurs almost exclusively in coastal drainages, from Monterey County, California, south into northwestern Baja California, Mexico. Through field reconnaissance and the study of preserved museum specimens we determined that the four reported populations of the arroyo toad from the Sonoran Desert region of Riverside, San Diego, and Imperial counties, California are in error. Two additional sites in the Sonoran Desert are discussed regarding the possibility that the arroyo toad occurs there. We recommend the continued scrutiny of arroyo toad records to maintain a high level of accuracy of its distribution and geographic extent.

The arroyo toad (*Anaxyrus californicus*) is considered a habitat specialist that is restricted to drainage segments characterized by low gradient (ca. 2% slope) river beds, with substrate predominantly composed of sand, gravel, and cobble. The distribution of the arroyo toad includes drainages along the Coast Ranges from Monterey County, California, south to the Transverse Ranges and south along the Peninsular Ranges into northwestern Baja California, Mexico, from near sea level up to 2440 m (Stebbins 2003; Sweet and Sullivan 2005). The species geographic range is almost entirely within areas with a semi-arid Mediterranean climate except for a few disjunct populations that are located in the arid desert. As a result of a severe population decline throughout its range, the arroyo toad was listed as endangered by the U.S. Fish and Wildlife Service (USFWS) in 1994.

The geographic range of the arroyo toad had been determined by the use of locality records from museum specimens, published peer reviewed literature, unpublished studies, archived field notes, and/or input from experts (Grinnell and Camp 1917; Stebbins 1951; Price and Sullivan 1988; Sweet 1992; Jennings and Hayes 1994; Campbell et al. 1996; USFWS 1999b). The species account and accompanying locality map published by Jennings and Hayes (1994) included two previously recognized desert populations located

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Fig. 1. A red-spotted toad (*Anaxyrus punctatus*) photographed on 10 April 1992 in Whitewater Canyon. University of Kansas Herpetology collection (KU 10123).

in the Mojave Desert (e.g., Little Rock Creek and Mojave River), as well as four additional desert populations in the Sonoran Desert (e.g., Whitewater River, San Felipe Creek, Vallecito Creek and Pinto Canyon). Of the six desert locations, both records from the Mojave Desert are corroborated by field observations and preserved museum specimens. The four records from the Sonoran Desert are supported by museum specimens (e.g., San Felipe Creek, Vallecito Creek) or by photographic vouchers (e.g., Whitewater River), while an observation only record is reported from Pinto Canyon. Because the Sonoran Desert records represented localities that seemed uncharacteristic for the species, we conducted an investigation to verify the validity of these records.

Methods

The USFWS Recovery Plan (1999b) for the arroyo toad provided supporting details of occupied areas (e.g., date reported, observer name(s), and institutions name and catalogue numbers of voucher specimens). To verify the identity of the preserved specimens, representing three of the four questionable populations, we requested loans from the following institutions: University of Kansas; Museum of Zoology, University of Michigan; Museum of Vertebrate Zoology, University of California. We provide photographs of all records supported by museum vouchers (figures 1, 2, 3). The three preserved tadpoles, representing the Vallecito Creek record, were examined and photographed using a digital microscope, Model QX3, Mattel + Intel, at 60 × magnification. Terminology and numerical representation for preserved tadpoles follows Altig (1970). The observer for the undocumented record from Pinto Canyon was interviewed. We also visited all four of the reported localities. The Pinto Canyon locality was surveyed once at night in March 2000, the Palm Spring locality was visited once during the day in May 2000, the Borrego Springs locality was surveyed once at night in

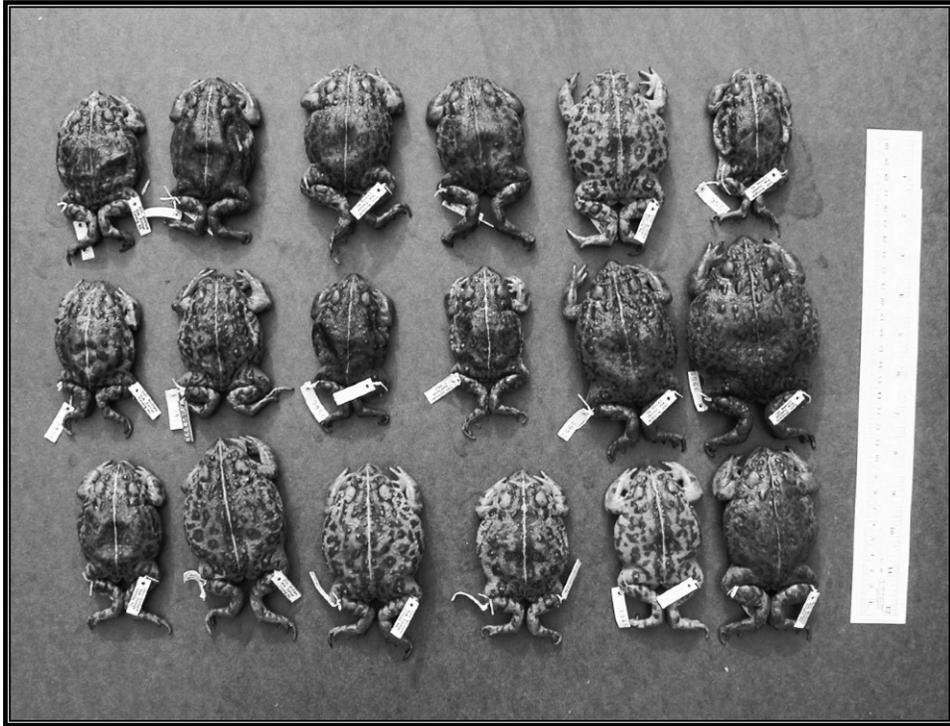


Fig. 2. A series of 18 whole specimen adult western toads (*Anaxyrus boreas*) collected on 25 July 1950 from Borrego Springs. University of Michigan Museum of Zoology (UMMZ 102332).

May 2001, and finally, the Whitewater Creek locality was surveyed on multiple dates in 2001 and 2003. We also include brief discussions of two additional sites that are relevant to the clarification of the range boundary at the coastal-desert interface. Names used for the four Sonoran Desert locations are from the USFWS Recovery Plan (1999b). Taxonomy follows Frost et al. (2008).

Results

Whitewater River Basin / Whitewater River

The Whitewater River record from Riverside County was first reported by Patten and Myers (1992). In an updated species account by Jennings and Hayes (1994), the Whitewater River population was included as one of six desert populations. Additional details of the Whitewater River record were provided in the USFWS Recovery Plan (1999b). Following the initial report of the Whitewater River record, conversations among regional biologists suggested that despite many independent visits to the area, no additional observations of the arroyo toad had been made. In 2001 and 2003, toad surveys conducted by the U.S. Geological Survey (Brown and Fisher 2002; Hitchcock et al. 2004), did not detect the species, although other anurans, such as the western toad (*Anaxyrus boreas*), red-spotted toad (*A. punctatus*), California treefrog (*Pseudacris cadaverina*), and Baja California treefrog (*P. hypochondriaca*) (previously the Pacific treefrog, *Pseudacris regilla*) were present. The initial report of the Whitewater River record included photo documentation (Patten and Myers 1992). Upon examination of the original photographs, we determined that the individual depicted was an adult red-spotted

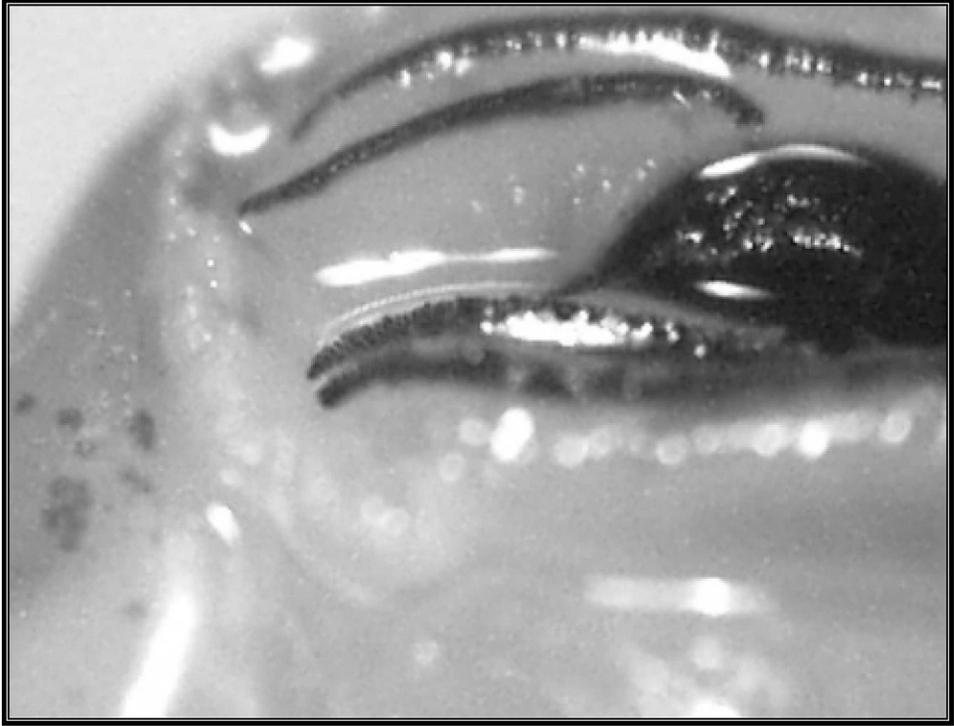


Fig. 3. Mouth parts of a California treefrog (*Pseudacris cadaverina*) tadpole collected on 12 April 1954 from Palm Spring, Anza-Borrego Desert State Park. Museum of Vertebrate Zoology, University of California (MVZ 61061).

toad, not a juvenile arroyo toad (figure 1). Our determination was based on diagnostic characteristics such as the compressed body form, nearly round parotid glands and the nose shape as more pointed than blunt and rounded as it is in the arroyo toad. Based on our reevaluation of the photographic vouchers (KU 10123–10125), the record for the arroyo toad from the Whitewater River is considered in error. There is also no evidence for the occurrence of the arroyo toad from any other locations within the Coachella Valley, Riverside County. Based on recommendations by one of us (RNF), the U.S. Fish and Wildlife Service has reconsidered the critical habitat designation for the arroyo toad for the Whitewater River area, making the determination that the area does not meet the criteria for critical habitat for the species (USFWS 2011).

San Felipe Creek Basin / Borrego Springs

Jennings and Hayes (1994) reported the San Felipe Creek record from San Diego County in a list of six reported desert locations. Additional details on the San Felipe Creek population were provided in the USFWS Recovery Plan (1999b). This record is represented by a series of 18 preserved specimens in the Museum of Zoology, University of Michigan (UMMZ 102332). On 25 July 1950, during a visit to San Diego, W. Duellman and R. Porter collected a series of 18 adult toads from ‘Country Club at Borrego’, San Diego County (USFWS 1999b). At the time these toads were collected and accessioned into the UMMZ collection, there was considerable disagreement over the taxonomic relationships within the Americanus group of genus *Bufo* (*sensu lato*).

The specimens (UMMZ 102332) were originally deposited and cataloged as “arroyo toads”, *Bufo californicus*, following the taxonomy of Myers (1930). The scientific name of these specimens in the collection was subsequently updated to *Bufo woodhousii* ssp. *californicus*, following the taxonomy of Linsdale (1940) and Shannon (1949) (G. Schneider, pers. comm.). We requested a loan of the series of 18 specimens. All specimens of lot UMMZ 102332 were re-identified as western toads, not arroyo toads (figure 2). This identification error is also supported by five decades of field surveys at this location by J. Copp, California Academy of Sciences, who has only observed western toads at this location (J. Copp, pers. comm.). Additionally, this locality was included in a study that examined an amphibian community within a desert environment and the only amphibian species detected at this site was the western toad (Warburton et al. 2004). Based on our reevaluation of the series of UMMZ specimens, the record for the arroyo toad at ‘Country Club at Borrego’ location is in error. There is no evidence that the species occurs within the San Felipe Creek watershed, San Diego County.

Vallecito Creek Basin / Palm Spring

The collection location of the single record within the Vallecito Creek Basin is Palm Spring, a freshwater oasis that occurs adjacent to the main dry wash of Vallecito Creek. The Vallecito Creek record was included on distribution maps in an unpublished report for the U.S. Forest Service, Los Padres National Forest (Sweet 1992) and by Jennings and Hayes (1994). Sweet (1992) based his record on a re-identification of three tadpoles (MVZ 61061) collected on 12 April 1954, by R.C. Stebbins from Palm Spring (Anza-Borrego Desert State Park), Vallecito Creek Basin, San Diego County that were originally identified as the canyon treefrog, *Hyla arenicolor* (now the California treefrog, *Pseudacris cadaverina*). Additional information for this record was provided in the USFWS Recovery Plan (1999b).

We examined R.C. Stebbins’s original field notes and they corroborate his original identification as “*Hyla arenicolor*”. It should be noted that during the tadpole phase both the California treefrog and arroyo toad can share a similar pattern and color scheme that closely resembles the sandy substrate of the pools they occupy (Ervin 2005; Sweet and Sullivan 2005). We used a digital microscope (QX3, Mattel + Intel) to view and photograph the morphological characteristics of the three preserved tadpoles. Because preserved tadpoles undergo some degree of integument deformation through time, which may alter eye position and or vent position relative to other features, and cause fading of color pattern and other markings, we used oral disc morphology to determine the identity of the tadpoles. We used illustrations in Storer (1925) and Gaudin (1964), and a color macrophotograph in Lemm (2006) as identification resources of mouth shape and labial tooth row pattern. Terminology and numerical representation in Altig (1970) were used to describe the tadpoles. The tadpoles, composing lot MVZ 61061, all had two rows of anterior labium, the second row had a median gap, three rows on the posterior labium, with the third row about $\frac{1}{2}$ the length of the second, with sub-marginal papilla, and an oral disk lacking lateral emargination (indented). These characteristics are consistent with the mouth parts of the California treefrog shown in Storer (1925), Gaudin (1964), and Lemm (2006). Lateral emargination of the oral disc is lacking in the California treefrog (consistent with our findings) and is present in the arroyo toad (figure 3). Therefore, based on diagnostic mouthpart characteristics, the three tadpoles (MVZ 61061) cannot be attributed to North American Bufonidae (Lemm 2006; Altig and McDiarmid 1999), and are that of the California treefrog, which concurs with the original identification of R.C.

Stebbins. Based on our reevaluation of the tadpole specimens, the single record for the arroyo toad within the Vallecito Creek Basin is in error. There is no evidence that the arroyo toad occurs in the Vallecito Creek Basin, Palm Spring, San Diego County.

Pinto Wash Basin / Pinto Canyon

Jennings and Hayes (1994) reported the Pinto Wash basin record, located in Imperial County, and included it in a list of desert populations. The location and some additional information for this record were provided in the USFWS Recovery Plan (1999b). This record is based on the observation made in 1992 by M. Feldner who observed recently transformed toadlets in Pinto Canyon at the second palm oasis upstream from the mouth of the canyon. On 27 March 2000, eight years after the original observation had been made, J. Stephenson (USFWS) corresponded with M. Feldner, regarding his observation of toads in Pinto Canyon, and was able to obtain additional information regarding his observations; M. Feldner stated that the toads that he observed were most likely red-spotted toads (M. Feldner, in litt.). On 31 March 2000, one of us (ELE) and J. Stephenson, visited the Pinto Canyon location where the toadlets had been observed. Between 1948–2055 hrs (PST), 11 adult red-spotted toads were observed along a short stretch of the stream in quiet pools and another 32 adult toads in a series of pools near the “second palm oasis” (E. Ervin, unpub. field notes). Males were observed calling, although no amplexus was observed. California treefrogs were also present at both locations, but were not observed at the breeding pools. It was determined that this location did not support suitable habitat for the arroyo toad (described above); however the habitat was typical for the red-spotted toad (Sullivan 2005). The original observers did not document their observations by either photographs or collecting voucher specimens, which made it difficult to reevaluate what species of anuran was originally observed. Based on our evaluation of these circumstances, the report of arroyo toads in Pinto Canyon is considered in error. There is no evidence that the species occurs in Pinto Canyon, Imperial County, which concurs with the USFWS revised rule for critical habitat for the arroyo toad (USFWS 2011).

Coyote Creek, San Diego County

Although we are not aware of any validated reports of arroyo toads from Coyote Creek, Anza-Borrego Desert State Park, San Diego County, the riparian habitat is similar (e.g., low gradient channel, sandy substrate, and seasonal hydrology) to sites in coastal San Diego County, where the species is known to occur. We provide a brief discussion of the Coyote Creek survey results because they are relevant to the clarification of the range boundary of the arroyo toad at the coastal-desert interface. This location was part of a study that examined an amphibian community within a desert environment (Warburton et al. 2004). In 2000 and 2001 daytime habitat assessment and nighttime amphibian surveys were conducted in the Upper, Middle, and Lower Willows areas of Coyote Creek. Despite favorable environmental conditions during the surveys, no arroyo toads were observed. Other anuran species observed included, western toad, red-spotted toad, California treefrog, and Baja California treefrog (Warburton et al. 2004). Based on the results of the habitat assessment and nighttime surveys our conclusion is that the arroyo toad does not occur in this drainage.

Banner Canyon, San Diego County

While investigating historic arroyo toad localities from San Diego County, a previously unreported observation was discovered. On 1 June 1935, L.M. Klauber recorded in his field notes (<http://archive.org/details/1935fieldnotesla00klaub>):

“At the foot of Banner Grade at 11:45 [pm]. Much colder here than on the desert. Lost a large snake at this point by not stopping quickly enough. I didn’t see it at all but Cy did, and we found the track. Heard *Bufo californicus* trill at this point. Quite cold going up the grade.”

However, based on preliminary assessments of the landscape, the area “at the foot of Banner Grade” is similar (e.g., low gradient channel, sandy substrate, seasonal hydrology and suitable upland habitat) to sites in coastal San Diego County, where the species is known to occur. There have been no subsequent reports or documentation of the arroyo toad from this locality (R. Fisher, pers. obs.).

Discussion

Due to the endangered status of the arroyo toad, it is critical that proper validation be employed by anyone detecting the species in the wild. Contingent upon environmental conditions this species can be difficult to detect at night, with major differences in detection between nights and also across years at the same sites (Sweet 1992, 1993; Miller et al. 2012). The larval stage can be easier to detect than transformed stages, although they are useful only when breeding habitat is present, which is highly variable inter-annually (Miller et al. 2012). Since the tadpoles can be confused with other species validation should include high resolution photos *in situ*. Or in the case where the observer is permitted to do so, a tadpole should be collected and deposited into the collection of a regional natural history museum to represent the breeding arroyo toad population at that location on that date. Additional benefits of having the tadpole in a publicly accessible collection are that it would be available for future examination as well as for genetic investigations.

We also support the position that it is not enough to be a skilled and knowledgeable biologist to correctly identify an arroyo toad in the field; in most cases it requires an individual that has firsthand experience with and knowledge of the given life history stage at issue (adult, recently transformed toad, larvae, egg strings). Firsthand experience with and knowledge of the seasonal male advertisement call characteristics is also important so it can be distinguished with certainty from the other natural “trilling” sounds produced by sympatric or parapatric species (red-spotted toad, *Anaxyrus punctatus*; Lesser Nighthawk, *Chordeiles acutipennis*; and possibly insects).

Natural history museums are in the business of biodiversity science and archived voucher specimens constitute their foundation, allowing researchers the ability to reconstruct the past and make predictions regarding the future (Shaffer et al. 1998). These specimens document the identity, ecology, spatial distribution, and natural history of this biodiversity, and provide important material for addressing questions related to ecology and evolution (Duellman 1999; Krishtalka and Humphrey 2000; Suarez and Tsutsui 2004). Specifically, our results emphasize the critical and fundamental role that museum vouchers (e.g., adult and larval specimens, photographic images) and archived field notes serve. They enabled us to reexamine vouchered material that led to our conclusion that there never was evidence that the arroyo toad occurs within the Sonoran Desert.

Conclusions

Herein we present evidence that the arroyo toad (*Anaxyrus californicus*) is not confirmed to occur within the Sonoran Desert portions of Riverside, San Diego, and Imperial counties, California. In the Mojave Desert, the species is currently known from two areas, Littlerock Creek, Los Angeles County and the Mojave River Watershed, San

Bernardino County. The validity of the Banner Canyon record reported here remains in question. This locality and other sites along the coastal Sonoran Desert ecotone that support the combination of characteristics of occupied habit elsewhere (coastal vegetation, low stream gradient, sandy substrate), where potential habitat loss may occur, can be addressed with USFWS arroyo toad protocol surveys (USFWS 1999a).

The information presented herein is important for the continued management and recovery of the endangered arroyo toad. Due to a reevaluation of the evidence supporting four previously recognized populations, there are no longer any valid records of the arroyo toad within the Sonoran Desert bioregion. Two of the four purported Sonoran Desert localities, previously included in critical habitat designation for the species (Whitewater Creek, Riverside County; Pinto Canyon, Imperial County), were not included in the revised critical habitat designation (USFWS 2011). It is suggested that all resource agencies and conservation groups with arroyo toad management programs can reflect the adjusted range boundary to no longer include the Sonoran Desert bioregion. This change reflects a more accurate delineation of the geographic range for the endangered arroyo toad in the area of the coastal-desert interface.

Acknowledgements

We are grateful to Greg Schneider of the Museum of Zoology, University of Michigan and Javier Rodriguez-Robles of the Museum of Vertebrate Zoology, University of California, for the loan of specimens, UMMZ 102332 and MVZ 61061, respectively. John Simmons of the University of Kansas, for the loan of 35 mm slides (KU 10123–10125), and Shawn Kuchta of the Museum of Vertebrate Zoology, University of California, for providing us with copies of collector's field notes. We also thank John Stephenson of the U.S. Fish and Wildlife Service, Carlsbad Field Office, California, for organizing and participating in the survey of Pinto Canyon. And finally, we thank Chris Brown, Mark Jennings, Norman Scott, and Samuel Sweet for reviewing and providing useful comments on our manuscript. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government. This is contribution number 454 of the U.S. Geological Survey Amphibian Research and Monitoring Initiative (ARMI).

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