Share With Wildlife 2013 – Final Report

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PROJECT TITLE: Current status of the Arizona Toad (*Anaxyrus microscaphus)* in New Mexico: Identification and evaluation of potential threats to its persistence

ABSTRACT

The toad species *Anaxyrus microscaphus* is a State of New Mexico designated sensitive species, although direct and indirect threats may warrant a re-evaluation of this conservation designation. *Anaxyrus microscaphus* has a relatively small range in New Mexico occurring in disjunct tributaries in Catron, Socorro, Grant and Sierra counties. We find that this species faces serious conservation threats from climate change, fire, and potential hybridization with *A. woodhousii*. Our surveys occurred from 2 March through 19 July, covering the breeding season of both toad species. We found *A. microscaphus* present at two of our four original focal sites. Soil erosion from recent fires, and higher than normal water levels, precluded breeding from the two focal sites along the Gila River. Additionally, we sampled 59 historic populations and found toads present at 9 sites (15%), suggesting severe population declines. Our results provide evidence that *A. microscaphus* is declining in New Mexico and warrants further study and conservation action. Further study in 2014 would elucidate if inter-annual population and weather variability resulted in the low percentage of occupied sites. This should be a priority in 2014 as further sampling would provide two consecutive years of data to confirm the 2013 results. A second year of data would provide conservation managers with a better understanding of the status of this species' decline and help design mitigation measures.

INTRODUCTION

Although this toad species is currently listed as Sensitive and is considered vulnerable in New Mexico, no comprehensive review of its distribution has been recently conducted. This species is primarily a riparian inhabitant known from tributaries in southwest New Mexico in Catron, Grant, Sierra, and Socorro Counties. While the original proposal focused on hybridization as a primary threat to *A. microscaphus*, during the course of our fieldwork we discovered that climate change (drying of streams) and forest fires are a much more serious threat to this species.

Herein we present the results from our study on the threats and population assessment of *A. microscaphus* in New Mexico.

Methods

We conducted focused breeding surveys at sites along the Gila River at Turkey Creek, Middle Fork of the Gila River, the Tularosa River at Hell Hole and the Mimbres River. These four focal sites were selected using historic museum records for Arizona Toads (*A. microscaphus*) with emphasis on sites also containing Woodhouse's Toads (*Anaxyrus woodhousii*). River conditions were poor for sampling along the Middle Fork due to above-average river flow and extremely turbid and silt-laden water conditions. We surveyed the Middle Fork five times, but deemed it unsafe for sampling because conditions did not improve as the season went progressed. We added Little Creek, a site approximately 4 km from Middle Fork, as an alternative site due to the poor water conditions.

Anaxyrus microscaphus breeds in early spring and is known as an explosive breeder in New Mexico (W. Degenhardt UNM, R. Jennings WNMU, personal communication), with all breeding activity occurring in just a few days. Therefore, we began sampling for *A. microscaphus* on 10 March 2013 to establish presence/absence, breeding activity, and relative abundance at the four focal sites. Breeding surveys included call surveys (presence of calling males), observations of amplectant pairs of males and females, and the presence of egg masses and tadpoles. Each focal site was visited weekly through 28 May 2013 to monitor tadpole development as an assay of *A. microscaphus* breeding success and to survey for *A. woodhousii*. During each survey we recorded data on all observed species of amphibians and reptiles (Appendix I), presence of the invasive species *Orchonectes virilis* (Northern Crayfish) and *Lithobates catesbeianus* (American Bullfrog) and other New Mexico Department of Game and Fish (NMDGF) designated Species of Greatest Conservation Need.

We conducted additional presence/absence and breeding surveys at 59 unique historical localities throughout the Gila National Forest to determine the current population status of *A. microscaphus* in the region (Figure 1). We used call surveys and/or visual encounter surveys (VES) for adults and tadpoles where appropriate. In some cases historical populations were on private land adjacent to public roads, which precluded the use of visual encounter surveys. In these situations, we utilized call surveys from the road and did not enter the private land. Historical populations on Public Lands were surveyed using both call and VES methods. In addition to call and visual encounter surveys, we assessed stream and river conditions and surveyed for *L. catesbeianus* and *O. virilis*.

We collected 33 chytridiomycosis disease swabs from a subset of *A. microscaphus* to determine disease prevalence at each locale. Due to low observed abundances, our sample sizes are small. We will be analyzing these samples in early 2014.

We collected museum vouchers and liver tissue samples that are housed at the Museum of Southwestern Biology at the University of New Mexico. Sub-samples of the liver tissues have been sent to Dr. Robert Lovich for molecular and phylogenetic analyses to determine if hybridization has occurred between *A. microscaphus* and *A. woodhousii*. Additionally, the molecular data will be used to determine the phylogenetic relationship of New Mexico populations of *A. microscaphus* to those in Arizona, Nevada, and Utah. Upon completion, these results will be provided to NMDGF.

RESULTS

We found *A. microscaphus* to breed at Little Creek, Hell Hole, and the Upper Mimbres, and we found no evidence of breeding at Turkey Creek and Middle Fork (Table 1). Additionally, we observed breeding at our alternative site, Little Creek. While breeding activity of *A. microscaphus* was observed at three sites, only two sites can be deemed to have bred successfully in 2013, Little Creek and Hell Hole. At some point in late April a catastrophic flood occurred along the Upper Mimbres before tadpoles completed development, likely resulting in 100% mortality of this year's cohort.

The two sites that did not have *A. microscaphus* were along the Gila River, which was severely affected by the fires of 2011. *Anaxyrus microscaphus* requires low flow-rates and clear water conditions for breeding (Schwaner and Sullivan 2009). Despite our lack of observations, the absence of *A. microscaphus* reproduction at Turkey Creek and Middle Fork in 2013 does not necessarily mean that this species is extirpated from these sites.

The fungal disease *Chytridiomycosis dendrobatidis* (Bd) was detected on *A. microscaphus* at Little Creek. No other sites or species tested positive for Bd. This is the first documented positive Bd test in *A. microscaphus*, despite much testing in Arizona.

Below we discuss the site-specific results.

Turkey Creek/Gila River. Grant Co., NM (UTM 12S 733483 E 3661954 N; 1462m elev.)**;** Dates Surveyed: March 11, 22; April 4, 18; May 8.

We did not observe breeding activity, egg masses or tadpoles of *A. microscaphus.* We sampled approximately 4 km of the Gila River at Turkey Creek. We observed very few *L. catesbeianus* and no *O. virilis* at Turkey Creek. From previous work by MJR and IML, we know both invasive species occur in high densities at this site. The high flow rates and heavy silt load likely contributed to the lack of detection of *A. microscaphus*, *L.*

catesbeianus, and *O. virilis* at Turkey Creek. *Anaxyrus woodhousii* was not observed at this site.

Because of poor conditions at Turkey Creek, we also sampled the Gila River Riparian Preserve (UTM 12S 730764 E 3660039 N; 1474m elev.) approximately 2.5 km downstream from the Turkey Creek/Gila River site. This site was sampled on March 24 and April 5, 18, 25 and we did not observe *A. microscaphus*. River conditions at this site were similar to those at Turkey Creek. *L. catesbeianus* were observed at this site, while *O. virilis* and *A. woodhousii* were not detected. The absence of any observed breeding activity, egg masses and tadpoles suggests that no *A. microscaphus* reproduction occurred at either Turkey Creek or the Gila River Riparian Preserve in 2013.

Middle Fork/West Fork Gila River. Catron Co., NM (UTM 12S 757121 E 3679681 N; 1787m elev.); Dates Surveyed: March 11, 23, 29; April 4, 20.

We did not observe breeding activity, egg masses or tadpoles of *A. microscaphus*. River flow was abnormally high with turbid and silt-filled water conditions due to last year's fires (Figure 2, photos 7-8). We surveyed 10 km along this stretch of the Gila River with poor water quality conditions persisting through late May. Thus, the absence of any observed breeding activity and egg masses and tadpoles suggests that there was no breeding at the Middle Fork site in 2013.

We detected large numbers of *L. catesbeianus* along the Middle Fork, congregated along small sloughs and wetlands adjacent to the main channel. *Lithobates catesbeianus* were also found in warm springs along the river margins. We did not detect *A. woodhousii* or *O. virilis* along the Middle Fork, the latter likely due to high water levels and heavy silt load.

Little Creek. Catron Co., NM (UTM 12S 0759536 E 3677191 N; 1741m elev)**;** Dates Surveyed: March 10, 29, 30; April 13, 20, 26, 27; May 1, 5.

We observed large scale breeding along Little Creek that spanned a minimum of 3 weeks between 23 March and 13 April. Our observation of prolonged breeding, 3 weeks, at Little Creek is of important ecological significance because as this species has previously been considered an explosive breeder in New Mexico (Degenhardt et al. 1996; W. Degenhardt, R. Jennings, personal communication). Our observations suggests that *A. microscaphus* can breed for longer periods of time in New Mexico, similar to lower elevation populations found in Arizona, Nevada, and Utah (Schwaner and Sullivan 2009).

We observed amplectant pairs, egg laying, egg masses, and tadpoles (Figure 2, photos 1-

4). The water conditions along Little Creek were ideal for *A. microscaphus* throughout the year and this population successfully bred in 2013 (Figure 2, photos 5-6). We judged successful breeding based on metamorphosed toadlets leaving the stream in May.

We detected *L. catesbeianus* in low densities along Little Creek. All of the individuals observed were juveniles, possibly using Little Creek for dispersal due to the lack of suitable breeding habitat. It is likely that the ponds on the east side of Highway 15 are the local source of *L. catesbeianus* in Little Creek.

Orconectes virilis and *A. woodhousii* were not detected at this site.

Mimbres River near Cooney Rd. Grant Co., NM (UTM 13S 0221582 E 3659593 N; ~2090m elev.); Dates Surveyed: March 3, 11, 23; April 13, 22, 29; May 1; June 19.

Adult males, egg masses, and tadpoles of *A. microscaphus* were observed at this site. Abundances were low compared to other sites where we found breeding populations (See: Hell Hole and Little Creek). Water conditions were ideal for this species through early April, slow flowing, clear water with shallow pools. As of 26 April 2013 the stretch of the Mimbres River with tadpoles had dried up resulting in heavy mortality of this year's reproductive effort. Between 26 April and 8 May a catastrophic flood occurred in the Mimbres River scouring the riverbed and depositing deep layers of silt likely resulting in 100% mortality of this year's reproductive effort.

We did not observe *L. catesbeianus*, *A. woodhousii* or *O. virilis* at this site.

Hell Hole, Tularosa River. Catron Co., NM (UTM 12S 0714796 E 3739203 N; ~1880m elev.)**;** Dates Surveyed: March 21—22; April 4; May 31.

We observed large-scale breeding of *A. microscaphus* along the Tularosa River at Hell Hole spanning at least two weeks from 21 March – 4 April 2013. We observed amplectant pairs, egg masses and tadpoles. The river conditions at Hell Hole were ideal for *A. microscaphus* throughout the year with slow flowing, clear water interspersed with shallow pools (Figure 2, photos 9-10). This population likely successfully bred this year although surveys were not conducted at this site after 31 May 2013 and no toadlets were observed.

No *L. catesbeianus* were observed during our surveys but have been recorded in this watershed in the larger aquatic microhabitats (Jennings 2011), which were not sampled. *Orconectes virilis* were moderately abundant, while *A. woodhousii* was not detected. Tadpoles of one other amphibian species, the Canyon Treefrog, *Hyla arenicolor,* were observed syntopically with those of *A. microscaphus* at this site.

Supplemental Range Wide Survey Summary

According to Museum of Southwestern Biology records there are a total of 78 known unique population records of *A. microscaphus* in New Mexico (Figure 1). We visited 59 (76%) of the known sites during the course of this work, including our focus study sites. We were unable to visit 19 (24%) sites due to accessibility limitations. Each site was visited between 2 and 10 times (Appendix II). Supplemental surveys consisted of call surveys and, when appropriate, visual encounter surveys for adults, egg masses and tadpoles.

We detected *A. microscaphus* at 8 (14%) of the 59 historical sites, recorded one previously unknown population (Black Canyon Creek Gila Trout Restoration Site, Appendix II), for a total of 9 populations. Of the 59 sites sampled, 29 (49%) streams were dried and did not have water present during our sampling. Many of these streams appeared to have been dry for an extended period of time and lacked mesic streamside vegetation and xeric plants growing in and along the streambeds (oaks, conifer saplings, etc.). Of the 30 sites with flowing water 8 sites (27%) had toads present.

We present detailed comments below on two of the supplemental sites.

<u>San Francisco River</u>. Catron Co., NM (UTM 12S 0694360E 3691742N; ~1460m elev.); Dates Surveyed: 4 April 2013.

We observed one adult male *A. microscaphus* and heard one additional male calling at this site along the San Francisco River. Abundances were very low at this site and no amplectant pairs, egg masses, or tadpoles were observed. Water conditions were poor with extremely limited flow mainly consisting of small widely spaced pools and heavy silt loads.

We did not observe *L. catesbeianus*, *O. virilis*, or *A. woodhousii* at this site. A single *H. arenicolor* was observed at this site.

<u>Black Canyon Creek Gila Trout Restoration Site</u>. Grant Co., NM (UTM 12S 0776550E 3675648N; ~2060m elev.); Dates Surveyed: March 23, 29; April 18, 20; May 8.

This population represents a previously unknown population within New Mexico. We detected adults, egg masses, and tadpoles of *A. microscaphus*. Metamorphosed *A. microscaphus* toadlets were observed in May confirming successful reproduction at this site.

We did/did not observe *L. catesbeianus*, *O. virilis*, or *A. woodhousii* at this site.

Discussion

There are four major threats to *A. microscaphus* populations in New Mexico; climate change, forest fires, disease and hybridization. These threats vary in their severity and potential risk to the persistence and stability of *A. microscaphus* populations.

The two most severe and immediate threats to *A. microscaphus* are climate change and forest fires. Our results suggest that *A. microscaphus* is highly vulnerable to the impacts of changing fire regimes, flashfloods, and drought conditions. Recent droughts in New Mexico have been the result of a long-term regional drying trend in the southwestern United States (Seager et al. 2007). This drying trend is already changing the landscape of New Mexico through increased tree die-offs (Breshears et al. 2005), fire frequency and intensity (Allen et al. 2010). Future projections show that drought intensity and frequency is likely to increase (Gutzler and Robbins 2011) leading to decreased river and stream flows in New Mexico and the Southwest in general (Cayan et al. 2010). The combination of increasingly severe drought and fire conditions in the Gila region are likely to continue to threaten riparian species, such as *A. microscaphus*, in New Mexico by increasing soil erosion and flash floods, while decreasing water levels and quality (Cayan et al. 2010; Rieman et al. 2012).

It is clear from our study that indirect impacts from increased silt-load and flash floods negatively impact local annual reproduction and recruitment. Additionally, drought effects that lead to drying of streams decreases available breeding habitat. The strong drought of 2011—2013 resulted in the Mimbres River drying up along many stretches, resulting in egg and tadpole mortality. The effects of drought were also observed at many of the supplemental sites, with 50% of historical collection localities having no aboveground water flow. Many of these streams appeared to have been dry for many years.

The increased frequency of drought and fire events can have additive effects by reducing annual recruitment and increasing mortality leading to declining populations, thereby increasing their vulnerability to stochastic events and extirpation. We have provided evidence for the negative impacts of both drought and fire from both our focal population and regional surveys. The threats are often localized and variable in effect with some streams drying (i.e. Mimbres River and 29 dried streams) and others impacted by increased soil erosion and poor water quality (i.e. all Gila River populations).

Throughout our sampling, we were unable to detect breeding activity for *A. microscaphus* along the main channels (i.e. Middle Fork, Turkey Creek) of the Gila River. The Gila River was characterized by significantly high rates of water flow and heavy silt loads. The combination of these two factors resulted in poor water quality and decreased availability of slow moving, shallow channels necessary for the reproduction of *A. microscaphus*. These poor conditions were observed as far south as the Big Burro Mountains.

The presence of chytridiomycosis (Bd) in the Gila National Forest is another potential threat to *A. microscaphus* as Bd has affected other amphibians in the region (Bradley et al. 2002; Schlaepfer et al. 2007). Prior to our project Bd has not been found in field populations of *A. microscaphus* (Schwaner and Sullivan 2009). We collected disease swabs to assess prevalence of Bd in *A. microscaphus* at our focal sites and it was detected at Little Creek. This finding is not surprising considering Bd is known to be present in the Gila National Forest and has been linked to severe population declines of the federally protected Chiricahua leopard frog, *Lithobates chiricahuensis* (USFWS 2002), a species historically found in sympatry with *A. microscaphus*. Little Creek had the highest number of toad observations in 2013 and no moribund or dead toads were observed. It is unclear what effect Bd has had, or continues to have on *A. microscaphus* at Little Creek or elsewhere in the Gila region. It is encouraging that the infected toad came from one of the few sites that successfully reproduced. To assess the impact of Bd on *A. microscaphus* a forensic pathology study would be needed to assess the historical presence of *Bd* in museum specimens (i.e. Puschendorf et al. 2006). The presence of Bd in toads at Little Creek does not necessarily mean that Bd is a major threat because many anuran species and populations can persist with Bd infection (Kilpatrick et al. 2010). Before a determination Bd's threat level is considered we recommend a laboratory study and further field studies on the Bd-toad interaction.

The final major threat to *A. microscaphus* in New Mexico is congeneric hybridization. Hybridization can increase a species susceptibility to decline and complicate recovery and conservation efforts (Schwaner and Sullivan 2009). Hybridization between *A. microscaphus* and *A. woodhousii* has been documented in Arizona, Nevada and Utah over the last 50 years (Sullivan 1995; Schwaner and Sullivan 2009) leading to population declines and state protection of *A. microscaphus* in these states (Hammerson and Schwaner 2004). Altered flow regimes from dam construction and other anthropogenic factors, have facilitated hybridization between *A. microscaphus* and *A. woodhousii* (Bradford 2002; Hammerson and Schwaner 2004), but the exact mechanism is not completely understood. Over the last few decades *A. woodhousii* has expanded its range up river and stream systems in Arizona and Nevada replacing *A. microscaphus* with hybrids, thus reducing the historic range of *A. microscaphus* (Schwaner and Sullivan 2005).

We did not find any evidence of hybridization between *A. microscaphus* and *A.*

woodhousii. Two factors may be responsible for the lack of observed hybridization between these two species. First, in New Mexico, the breeding phenology of these two species is different, minimizing species interactions at breeding sites. In the Gila Region, *A. microscaphus* breeds in early spring (March and April) whereas *A. woodhousii* breeds later in the spring and summer months (Painter 1985). Second, the two species utilize different breeding habitats, further minimizing species interactions during the breeding season. *Anaxyrus microscaphus* is restricted to breeding in slow flowing and shallow streams (Schwaner and Sullivan 2009) and *A. woodhousii* breeds in ponds, cattle tanks, isolated pools along rivers and streams, and in water impoundments (Stebbins 1951; Sullivan 1982; Degenhardt et al. 1996).

A review of museum specimens did not show any evidence of hybridization between *A. microscaphus* and *A. woodhousii.* This suggests that in New Mexico hybridization is not currently a serious threat to the persistence of *A. microscaphus.* The small number of ponds, cattle tanks, or dams near our study sites likely prevents *A. woodhousii* from co-occurring in the same microhabitat as *A. microscaphus* even when they co-occur in the same general area. This is an important distinction that may prevent hybridization between these two species in the Gila Region. In many areas of the southwestern United States, dams provide breeding habitat for *A. woodhousii* within streams or riverbeds that leads to increased interspecific interactions and facilitating hybridization (Sullivan 1995). The lack of dams on the Gila has likely prevented *A. woodhousii* from expanding its range further up the Gila watershed as has been observed at sites elsewhere in the Southwest (Sullivan 1986, 1993).

Recommendations

The 2013 results suggest significant population declines or extirpations of *A. microscaphus* throughout the Gila, but we are cautious with this interpretation. Local amphibian populations are well known for year-to-year population variation making predictions of future population levels difficult (Alford and Richard 1999; Marsh 2001). Evaluation of local population viability is not possible with any certainty without conducting multi-year surveys. Still, the high number of unoccupied sites suggests that severe population declines of *A. microscaphus* have already occurred in New Mexico. We recommend monitoring, in 2014, of both the focal sites and historical localities in order to determine whether the observed presences/absences in 2013 are a result of inter-annual population fluctuations or represent actual local or regional declines and/or extirpations.

The health of riparian areas is vital for the continued persistence of *A. microscaphus* throughout its range. Drought and land-use change can have large impacts on the health of riparian areas, which are vital breeding habitat for many species of amphibians. The incorporation of rapid riparian stream assessments (Stacey et al. 2006) in amphibian surveys can allow for a quantitative assessment of stream health at breeding sites. The information provided by these assessments is likely to enhance our understanding of the necessary conditions for reproduction in *A. microscaphus*, further informing conservation management decisions and restoration efforts. Furthermore, any continuation of this project should involve site evaluations to select those current and former populations for focused management. This would be a cost-effective means to assess the extent of population declines, and provide NMDGF with valuable information to design and implement future conservation actions.

The lack of dams and water impoundments is likely preventing hybridization between *A. microscaphus* and *A. woodhousii*. Development of impoundments would increase opportunities for hybridization between the two species, and likely increase the further spread of *L. catesbeianus*. The ponds and pooled water behind water impoundments provide breeding habitat for *L. catesbeianus,* potentially increasing their population size and range within the Gila. This would negatively impact *A. microscaphus* by increased predation (Jancowski and Orchard 2013) and exposure to Bd, as *L. catesbeianus* is a known reservoir for Bd (Hanselmann et al. 2004; Pearl and Green 2005). Increased populations of *L. catesbeianus* in the Gila would impede current conservation actions with *L. chiricahuensis*, as well as add increased pressure on the remaining populations of *A. microscaphus* in New Mexico.

The outlook for *A. microscaphus* in New Mexico is not good. The loss of up to 50% of historic populations can lead to an extinction vortex that this species may not be able to recover from without conservation actions (Gilpin and Soule 1986). The observed loss of occupied sites is scattered throughout the range of *A. microscaphus*, effectively limiting potential natural recolonization probability through changes in metapopulation dynamics (Hanski and Gilpin 1997). It is natural for some portions of amphibian populations to become locally extirpated due to stochastic or natural events (Alford and Richards 1999). Under normal circumstances these populations are recolonized from nearby populations, in a process known as rescue effect (Brown and Brown 1977). High rates of local population decline and barriers to dispersal, such as roads and dams, can impede this process (Aström and Pärt 2013).

One potential mitigation measure to prevent further loss of populations of *A. microscaphus* could be to “seed” historically occupied streams with eggs and tadpoles from nearby populations to develop a metapopulation network. Continuation of this project in 2014 could identify those streams most suited for such an effort. In addition, further work may identify additional extant populations that could be used as source populations in future recovery efforts.

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