Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Ecology and Breeding Habitat of Colorado River Toads

2014 Annual Report

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

April 2016

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Lower Colorado River Multi-Species Conservation Program

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ACRONYMS AND ABBREVIATIONS

BWR	Bill Williams River
cm	centimeter(s)
CRTO	Colorado River toad(s) (*Incilius alvarius*)
GSM	global system for mobile communications network
ha	hectare(s)
m	meter(s)
LCR	lower Colorado River
Reclamation	Bureau of Reclamation

Symbols

≈	approximately
%	percent

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ABSTRACT

Colorado River toads (*Incilius alvarius*) (CRTO) are included on the Lower Colorado River Multi-Species Conservation Program's (Bureau of Reclamation 2004) list of evaluation species. Although periodic anecdotal accounts of the species occurring along the lower Colorado River (LCR) do arise, the species has not been officially confirmed in the Colorado River for several decades. This research was embarked upon in order to gain a better understanding of CRTO ecological requirements in hopes that they may be restored along the LCR. The objective of this project was to define the ecology and breeding habitat of CRTO. This was done to better define suitable habitat requirements for breeding in order to develop habitat selection criteria for desirable conditions in unoccupied habitat within the LCR for potential future reintroductions. The study areas included the Bill Williams River (BWR) upstream of Planet Ranch just east of the LCR as well as the Agua Fria and Verde River drainages near Phoenix, Arizona. Beginning in July 2014, habitat assessment surveys were performed throughout the study areas based on a Geographic Information System analysis of aerial imagery, remotely sensed data, and historic records specifically identifying flood plains with homologous vegetation communities and soil types. Areas identified with the analysis were then monitored by Arizona Game and Fish Department biologists in anticipation of CRTO breeding, with the goal of observing oviposition locations. During the 2014 field season, data on 19 egg masses were recorded from the BWR, Cave Creek, and Skunk Creek.

INTRODUCTION

Extirpated from the lower Colorado River (LCR), Colorado River toads (*Incilius alvarius*) (CRTO) still persist ≈11 miles east of the LCR along the Bill Williams River (BWR) (Brennan and Holycross 2006; Cotten 2011). CRTO are part of the Lower Colorado River Multi-Species Conservation Program and are identified as requiring evaluation for monitoring and restoration activities in their former range along the LCR and BWR (Bureau of Reclamation [Reclamation] 2004). Specific measures established in the Habitat Conservation Plan include: (1) conduct research to better define distribution, habitat requirements, and the factors that limit the distribution of CRTO, (2) protect existing unprotected occupied CRTO habitat, and (3) conduct research to determine the feasibility of establishing CRTO in unoccupied habitat (Reclamation 2004). CRTO are historically found in both the Sonoran and Chihuahuan Desert and occupy a variety of habitats including mesquite and creosote bush lowlands, arid grasslands, and oak-pine woodlands, typically within close proximity to permanent or predictable water (Brennan and Holycross 2006). The breeding season and general terrestrial behavior of CRTO is dictated by monsoon activity (July – September), with breeding occurring in ephemeral pools and swollen oxbows following large rain events (Sullivan and Malmos 1994; Sullivan and Fernandez 1999). Here, in the first year of a 2-year study, the ecology and habitat requirements of CRTO were examined and evaluated along the BWR, within the Agua Fria, and Verde River watersheds. Habitat was considered elsewhere within the Sonoran Desert but homologous to what is observed along the BWR. Surveys were conducted throughout the drainages for breeding toads or habitat which may support breeding toads before and after appropriate rainfall. Specific oviposition sites were recorded as well as oviposition clusters (locations of high egg mass concentration). This was done to better define suitable habitat requirements for breeding in order to develop habitat selection criteria for desirable conditions in unoccupied habitat within the LCR for future reintroductions under the Lower Colorado River Multi-Species Conservation Program.

OBJECTIVE

The objective of this project was to determine the ecology and habitat requirements of CRTO within the BWR, Agua Fria, and Verde River watersheds.

STUDY AREA

The study area occupies three different river drainages in western and central Arizona (figure 1). The BWR flows into the LCR near Parker, Arizona. The

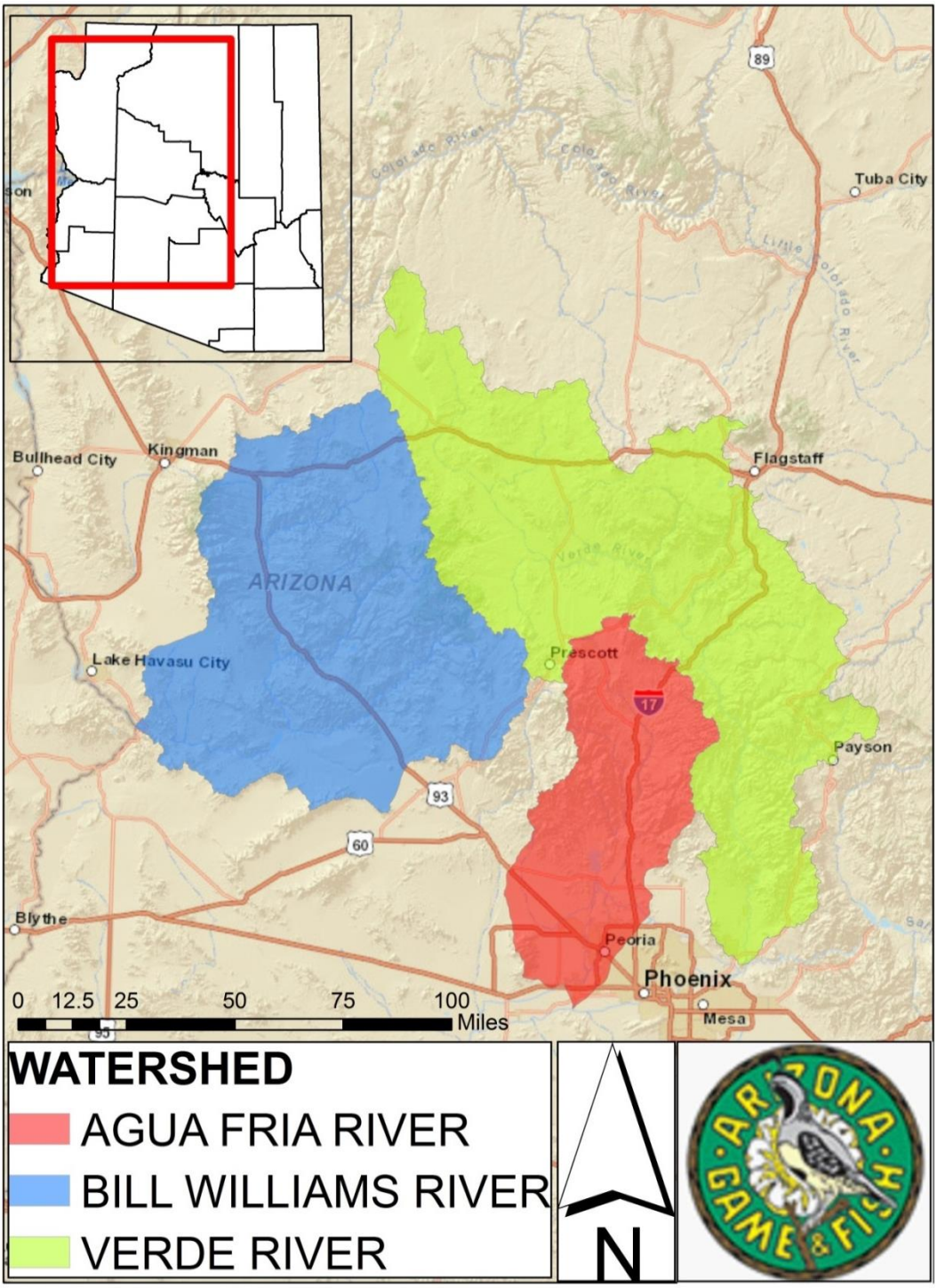

Figure 1.—Map of study areas within the Bill Williams, Verde, and Agua Fria River basins.

focus was on the area adjacent to Planet Ranch (private property) where Arizona Game and Fish Department biologists have been monitoring CRTO since 2011 (Cotten and Leavitt 2014) (see figure 1). In addition to this historic study population, toads were observed within the Agua Fria and Verde River drainages north of Phoenix, Arizona (see figure 1).

METHODS

A desktop review of available remotely sensed data was conducted, comparing historic CRTO localities from the BWR with vegetation types, soil characteristics, and known ephemeral pools within the Agua Fria and Verde River watersheds. This, combined with nocturnal surveys for foraging toads as well as consultations with species experts, allowed us to narrow down the study area to a series of locations within the watersheds (figure 2). The BWR was surveyed separately and within a fixed area where CRTO have been observed previously (Cotten and Leavitt 2014) (figure 3).

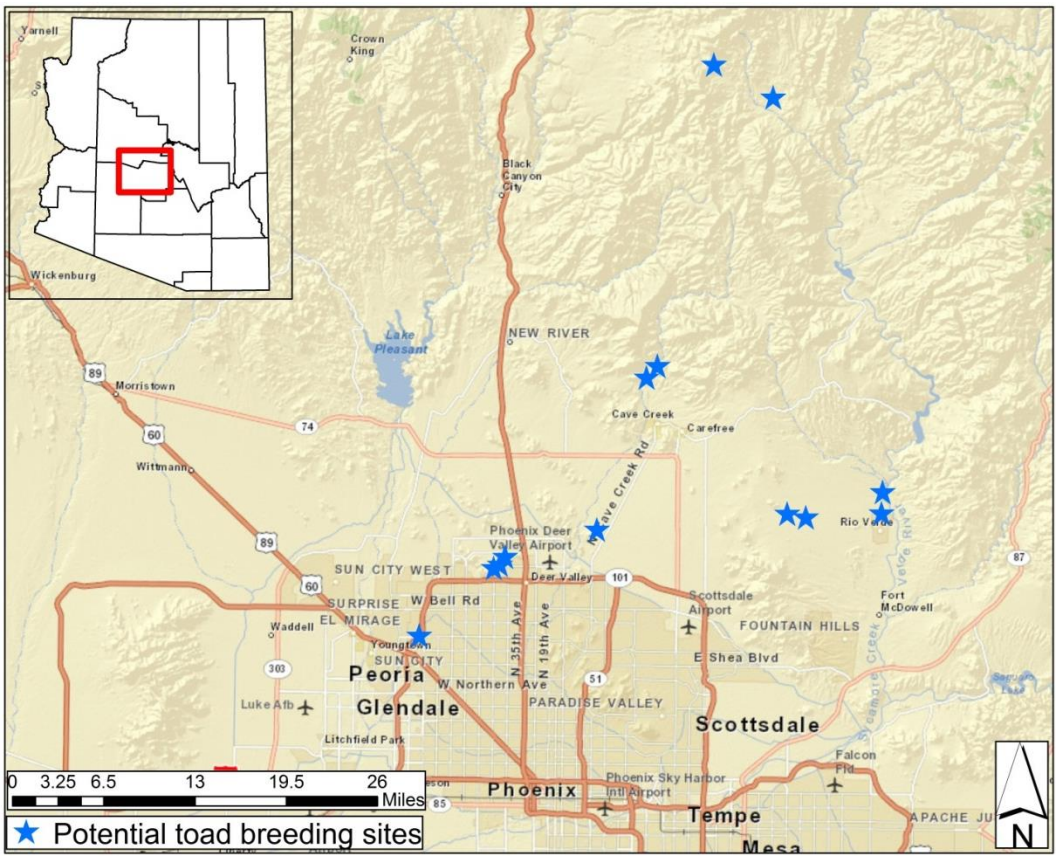

Figure 2.—CRTO activity locations monitored for breeding behavior within the Agua Fria and Verde River watersheds.

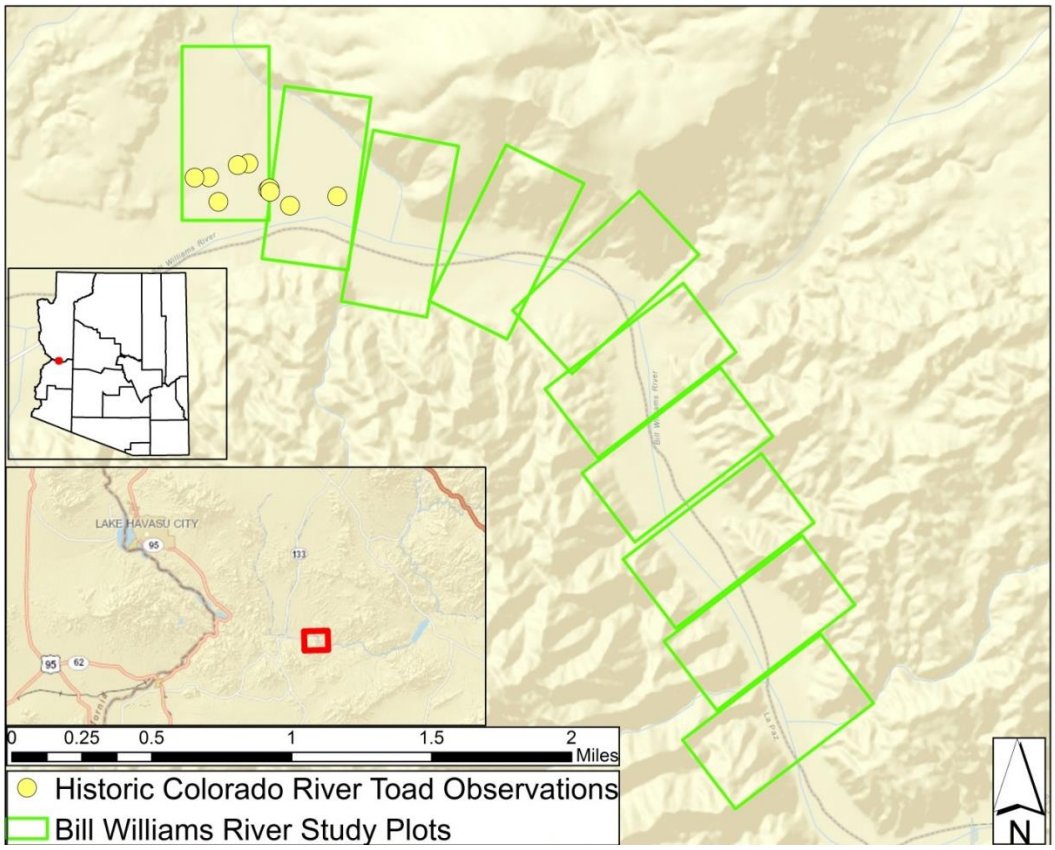

Figure 3.—CRTO study areas on the BWR.
Yellow circles indicate locations of CRTO observations in 2012 and 2013.

Study areas were initially surveyed prior to the monsoon season to narrow the study area to locations where toad activity was most likely to occur following heavy rainfall. These areas included shallow basins, washes, or impoundments where heavy monsoon rainwater could collect to create an ephemeral pool. These activity areas were then revisited occasionally throughout the field season to attempt to detect breeding behavior. The water at each breeding site was extremely turbid. In order to minimize the risk of overlooking egg masses in the murky waters after oviposition, amplectic pairs of toads were monitored closely in the anticipation of reproduction. When an oviposition site was located, a series of environmental variables at the site location and at a randomly selected "non-site" were recorded. Non-sites were selected at random within the habitat based on a random number generator for direction (angle) and distance with a minimum of 1 meter (m) and a maximum of 100 m. Data on clusters of egg masses (multiple egg masses within a 0.01-hectare [ha] radius) and randomly selected "non-clusters were also recorded." Environmental variables were collected that may contribute to breeding success at each of these locations.

To evaluate habitat selection at the cluster scale for sites and randomly selected non-sites, 0.01-ha plots were established similar to methods established by Peet

et al. (1998). Standard measurements taken at each cluster consisted of air and water temperature, minimum and maximum water depth, and the average of five random depth measurements throughout the cluster. Other variables measured were an estimate of how much of each plot was inundated with water, the substrate type, and if there was any discernable flow. Four 1 x 1-m quadrats were randomly selected within or adjacent to the 0.01-ha plot, and the vegetation and habitat within were quantified. Surveys were conducted between July 8 – September 30, 2014, and continued until the end of the breeding season, which is approximately September 30, 2014.

RESULTS

The BWR was visited and intensively surveyed every week from July 8 through October 4, 2014. During this time, two egg masses were identified following a large rain event. These two egg masses were 10 m apart and therefore represent the only cluster located along the BWR (figure 4). Calling male CRTO and amplectic pairs of toads were observed elsewhere within the BWR study area, but neither egg masses nor tadpoles were observed at these locations. In most cases, ephemeral pools where toads were active retained water long enough to facilitate reproduction.

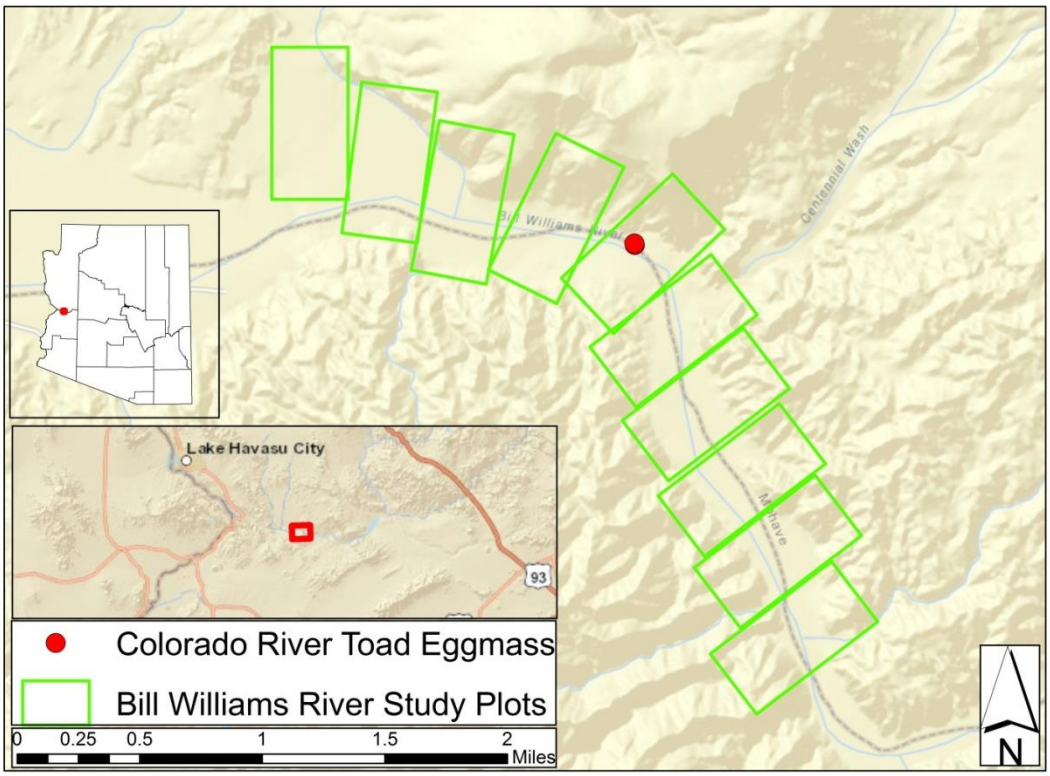

Figure 4.—CRTO egg masses observed on the BWR.
Red circles indicate locations of CRTO oviposition sites.

Forty-four and 39 nights were spent surveying the Agua Fria and Verde River drainages, respectively, throughout the field season. Eight areas were identified and regularly monitored within the Agua Fria and Verde River watersheds, which had significant numbers of CRTO foraging prior to monsoon activity and suitable areas for pooling water to facilitate breeding. Seventeen egg masses were located from the Agua Fria and Verde River drainages, which accounted for three clusters. Outside of the BWR, all of the oviposition sites came from only 2 general locations: 12 egg masses were observed from the Adobe Dam area on Skunk Creek (figure 5), and 5 were recorded on Cave Creek (figure 6). Male CRTO were observed calling at multiple other locations being monitored, but no egg masses or breeding behavior was observed. CRTO tadpoles and young-of-the-year were observed on subsequent surveys at multiple locations where egg masses were never observed. Egg masses were only recorded at two of the eight predetermined study areas.

All egg masses were positioned in pools of water either away from a main channel or residual pools left after the main channel receded. While toads were often present and displaying breeding behavior, eggs were never found in flowing water. Egg masses were found at a mean depth of 5.6 centimeters (cm), with the average distance from the bottom of the egg mass to the surface of the substrate being 15.1 cm. All the observed egg masses were in open canopies. The mean distance to a crawl space for each animal to leave the water was 271.9 cm, and the mean distance to dense cover was 1,110.4 cm. Thirteen egg masses were not attached to any vegetation and were stretched across the top of the substrate, three were attached to unidentified twigs or branches, and one egg mass was attached to each of the following: cattail (*Typha* sp.), Palo verde (*Parkinsonia* sp.), and mesquite (*Prosopis* sp). Three egg masses were found associated with a cobble substrate, with the other 16 found in mud/silt. At the egg mass cluster scale (0.01–1.00 ha), the mean water depth was 288.2 cm, with a mean maximum and minimum 574 and 2 cm, respectively (table 1). On occasion, portions of egg masses were desiccated due to dropping water levels and were not included in the measurements. Observations to document the hatch success of egg masses were not made.

DISCUSSION

CRTO breeding is strongly correlated with summer monsoon rain events (Sullivan and Fernandez 1999). In anticipation of this, a large amount of time was spent evaluating potential habitat prior to these rain events and monitoring each location during and following events. However, the relatively low number of egg mass observations is likely not representative of the total number of oviposition sites that occurred in the areas monitored.

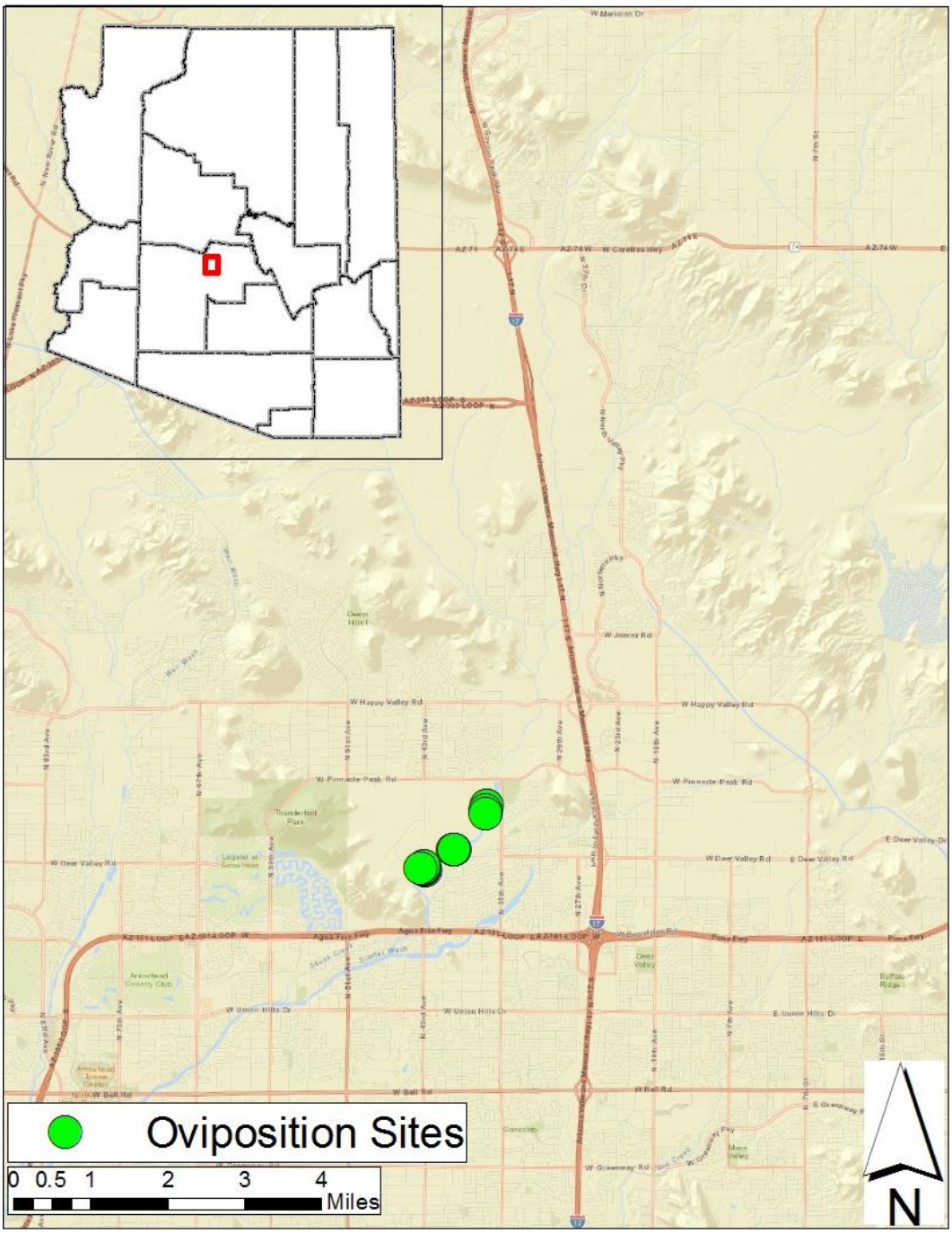

Figure 5.—Adobe Dam breeding sites for CRTO.
Green circles indicate egg mass observation areas.

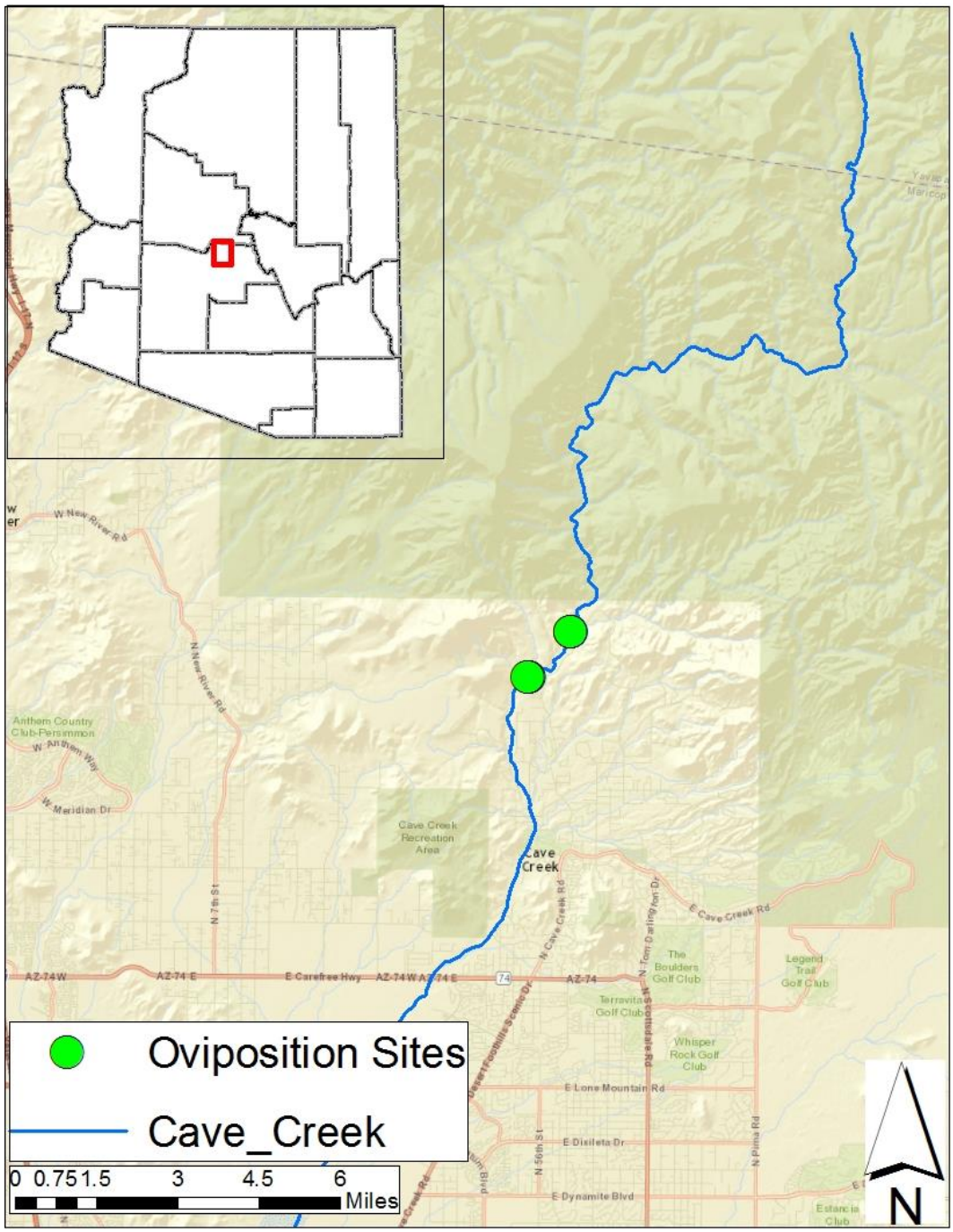

Figure 6.—Cave Creek breeding sites for CRTO.
Green circles indicate egg mass observation areas.

Table 1.—Environmental variables predicted to influence amphibian breeding habitat selection at multiple scales (Descriptions in attachment 1)

Scale	Variable	Units	Mean or tally (n = 19)
Oviposition site (microhabitat scale = ≈1 square m)	Vegetation attached to	Species (categorical)	None: 13, unidentified twigs/branches: 3, mesquite: 1, Palo verde: 1, cattail: 1
	Egg mass depth from surface	cm (continuous)	5.6
	Distance from bottom to egg mass	cm (continuous)	15.1
	Percent canopy cover	% (continuous)	0
	Species canopy cover	Species (categorical)	None
	Distance to dense cover	cm (continuous)	1,110.4
	Distance to a location to crawl out of water	cm (continuous)	271.9
	Substrate type	type (categorical)	Cobble: 3, mud/silt: 16,
Oviposition cluster (macrohabitat scale = ≈ 0.01 – 1.00 ha)	Average water depth	cm (continuous)	288.2
	Minimum water depth	cm (continuous)	2
	Maximum water depth	cm (continuous)	574

Much of the Agua Fria and Verde River sites were saturated and adequately inundated following a single week of rain during the 2014 field season. The Cave Creek breeding event occurred immediately following a heavy rain and flood event on July 26 and 27. Egg masses were found in ephemeral pools and oxbows that remained inundated after the flood waters receded. Similarly, all of the Adobe Dam (lower Skunk Creek) egg masses correlated with a heavy rain and flood on August 19. Egg masses were dissolving, in most cases, and tadpoles free swimming in 24–36 hours, making it even more important to be onsite and at as many locations as possible immediately following rains. Male CRTO advertisement calls were dramatically reduced or non-existent a few days after these major rains, suggesting the majority of the population at each site bred immediately following these isolated events.

A disproportionate amount of time was spent in the Agua Fria drainage compared to the Verde River drainage following the August 19 rains because of large numbers of male CRTO calling in the ephemeral pools at Adobe Dam. Once amplectic pairs were observed, each would be monitored throughout the night in anticipation of reproduction and in an effort not to overlook egg masses in the muddy water during subsequent surveys. However, egg laying behavior was never observed, and most amplectic pairs remained paired for the duration of the night well into the morning or separated in the early morning hours. The monopoly of the researcher's time in the field during the crucial days following the rains severely limited their ability to monitor multiple breeding areas. Subsequent visits to other survey sites revealed well-developed tadpoles and eventually juvenile toads from the 2014 season that were missed as eggs.

The two egg masses observed on the BWR were also found immediately following a monsoon rain in a swollen oxbow of the river. This section of the river had a thick clay layer at the surface of the riverbed, which held water much longer than other locations that had a sandy substrate, and is likely how the toads have bred in the region historically. Even with the relatively active monsoon in 2014, only locating two egg masses within this study area suggests breeding habitat may be scarce in this stretch of the BWR. The low flows of the BWR from Alamo Dam may also contribute to a lack of breeding habitat (Cotten and Leavitt 2014). Higher flows in the BWR may create more isolated pools adjacent to the river after monsoon floods suitable for breeding.

CRTO breeding lasted only a few days following major rain events. Other than the Cave Creek egg masses, most of the study area breeding activity followed the August 19 rains, and toads were finished breeding entirely by August 26. Critical time was spent monitoring amplectic pairs of toads at Adobe Dam within the Agua Fria drainage immediately following the August 19 rains, limiting the amount of sites that could be visited during this high activity period. Despite the risk of overlooking egg masses in murky water, it may be more efficient and effective to survey for egg masses the morning after breeding is observed as opposed to monitoring amplectic pairs during the night. By searching for eggs in

the mornings, more sites could be visited during the evenings when breeding occurs to record which areas will have potential for egg masses the following morning.

To assist with monitoring multiple locations at once, the Arizona Game and Fish Department is considering the feasibility of global system for mobile communications network (GSM) alarm/audio boxes. These units may be deployed anywhere with a reliable cell network (AT&T). The GSM alarm/audio box includes a weatherproof microphone that may be accessed via a mobile telephone. Theoretically, this technology could be deployed at high activity and potential CRTO breeding areas, and the biologists could then call the unit, listen for male CRTO advertisement calls over the phone, then make decisions on where surveys should be conducted to better target time in the field.

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ATTACHMENT 1

List of Environmental Variables Predicted to Influence Amphibian Breeding Habitat Selection at Multiple Scales and Their Descriptions

Variable	Description
Egg mass depth from surface	Distance of the top of the egg mass from the surface of the water column
Distance from bottom to egg mass	Distance from the surface of the substrate to the bottom of the egg mass in the water column
Percent canopy cover	Percent canopy cover directly above the egg mass
Species canopy cover	Tree or shrub species comprising the canopy cover
Distance to dense cover	Distance from egg mass to a terrestrial location containing a solid stand of vegetation at least 5 frog lengths wide
Distance to a location to crawl out of water	Distance from egg mass to any location where a frog may exit the water
Substrate type	Substrate category directly below the egg mass
Oviposition cluster (macrohabitat scale approximately 0.01–1.00 hectare)	
Average water depth	Average water depth throughout each 0.01-ha plot
Minimum water depth	Minimum water depth within each 0.01-ha plot
Maximum water depth	Maximum water depth within each 0.01-ha plot