

# AQUATIC HERPETOFAUNA INVENTORY OF FORT HUACHUCA AND VICINITY

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## EXECUTIVE SUMMARY

The Huachuca Mountains and surrounding sky islands have long been recognized to support a diverse and unique array of flora and fauna. Because of concerns over recent population declines or population vulnerability due to restricted distribution, six amphibians (Sonora tiger salamander, barking frog, and Huachuca treefrog, and Ramsey Canyon, Chiricahua, and lowland leopard frogs ) and one reptile (Mexican garter snake) have been afforded state or federal status designations. To gather baseline data on these herpetofauna in the Huachuca Mountains, Arizona Game and Fish Department and Fort Huachuca entered into a Department of Defense Legacy project (contract DABT63-95-P-2237). Specific tasks of this project were focussed on the herpetofauna listed above and were intended to 1) gather locality records from museums and other sources, 2) conduct two full years of field surveys, 3) develop a Geographic Information System (GIS) database, 4) develop an interim report (impacts to sensitive populations and mitigation techniques), 5) develop an administrative draft management plan, 6) develop a draft long-term management plan, 7) develop final long-term management plan, and 8) educate local land managers on basic biology of target herpetofauna. Portions of tasks 1, 2, and 4-6 have been submitted under previous communications and reports. This report summarizes herpetofaunal inventories and workshops (tasks 1, 2 [part], and 8). Sredl and Wallace (2000) summarize the management plan (tasks 2 [part], and 4-7), and GIS data have been submitted separately (task 3).

We report results of surveys initiated in the summer of 1995 and completed during the fall of 1998. Our study contributes to understanding of the region's herpetofaunal diversity, by providing a baseline for aquatic herpetofauna on Fort Huachuca and vicinity. Our surveys preliminarily suggest that populations of target herpetofauna occur in small, isolated aquatic sites. In most cases, habitable aquatic systems are either remnants of historically larger perennial aquatic systems that have now contracted or peripheral to a larger aquatic system that was inhabited by a large source population. With non-native species dominating these remaining core aquatic habitats, habitat for native herpetofauna is reduced to small, isolated pockets that are capable of supporting only small, unstable populations. The precarious state of habitats that support these species has created a critical need to develop general land management plans and species-specific conservation plans for many species of aquatic and semi-aquatic wildlife.

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# AQUATIC HERPETOFAUNA INVENTORY OF FORT HUACHUCA AND VICINITY

Michael J. Sredl, J. Eric Wallace, and Verma Miera

## INTRODUCTION

The Huachuca Mountains and surrounding sky islands have long been recognized to support a diverse and unique array of flora and fauna (Felger and Wilson 1995), including several amphibians and one reptile of limited geographical distribution. Sonora tiger salamanders, *Ambystoma tigrinum stebbinsi*, are found only in the headwaters of the Santa Cruz River in San Rafael Valley (Collins and others 1988). These mountains also support one of the few Arizona barking frog populations, *Eleutherodactylus augusti* (Alberti, Schwalbe, and Sticha unpubl data, Slevin 1931, Wright and Wright 1949, Zweifel 1956, Bezy and others 1966), and the area's only known population of Huachuca treefrogs, *Hyla wrightorum* (Gergus and others 1998). Ramsey Canyon leopard frogs, *Rana subaquavocalis*, are only known from a few sites along the eastside of the Huachuca Mountains (Platz 1993). Chiricahua leopard frogs, *R. chiricahuensis*, were once known to occur along the western and eastern slopes of the range (Platz and Mecham 1979, Holm and Lowe 1995) and lowland leopard frogs, *R. yavapaiensis*, from the valley bottoms to the north and east of the range (Platz and Frost 1984). Mexican garter snakes (*Thamnophis eques*) reach the northeastern limit of their contiguous range in this region (Stebbins 1985, Rosen and Schwalbe 1988). Because of concerns over recent population declines or population vulnerability due to restricted distribution, many of these species have been afforded state or federal status designations (Table 1).

To gather baseline data on the herpetofaunal community of the Huachuca Mountains, Arizona Game and Fish Department (AGFD) and Fort Huachuca entered into a Department of Defense Legacy project (contract DABT63-95-P-2237). Specific tasks of this project were focussed on the herpetofauna listed above and were intended to 1) gather locality records from museums and other sources, 2) conduct two full years of field surveys, 3) develop a Geographic Information System (GIS) database, 4) develop an interim report (impacts to sensitive populations and mitigation techniques), 5) develop an administrative draft management plan, 6) develop a draft long-term management plan, 7) develop final long-term management plan, and 8) educate local land managers on basic biology of target herpetofauna. Portions of tasks 1, 2, and 4-6 have been submitted under previous communications and reports. This report summarizes herpetofaunal inventories and workshops (tasks 1, 2 [part], and 8). Sredl and Wallace (2000) summarize the management plan (tasks 2 [part], and 4-7), and GIS data have been submitted separately (task 3).

## METHODS

Watersheds in the Huachuca Mountains flow toward three major rivers, the San Pedro River to the east, Babocomari River to the north, and Santa Cruz River to the west. Mild winters and warm summers characterize the climate in this region. Precipitation is bimodal; however, most

precipitation falls between July and August. A second peak occurs between December and March. The driest months are April and May (Sellers and Hill 1974).

Table 1. State and federal status designations for target herpetofauna of the Huachuca Mountains.			
SPECIES	STATUS		
	AGFD (in prep.)	USFWS (1996, 1997a)	USFS (1988)
Sonora tiger salamander ( <i>Ambystoma tigrinum stebbinsi</i> )	SC	E	S
barking frog ( <i>Eleutherodactylus augusti</i> )	SC		S
Huachuca treefrog ( <i>Hyla wrightorum</i> )	SC		
Chiricahua leopard frog ( <i>Rana chiricahuensis</i> )	SC	C	S
Ramsey Canyon leopard frog † ( <i>Rana subaquavocalis</i> )	SC		
lowland leopard frog ( <i>Rana yavapaiensis</i> )	SC		S
Mexican garter snake ( <i>Thamnophis eques</i> )	SC		S

AGFD = Arizona Game and Fish Department, USFWS = U.S. Fish and Wildlife Service, USFS = U.S. Forest Service. Abbreviations: SC = Special Concern, E = Endangered, C = Candidate, S = Sensitive within Coronado National Forest

† Conservation agreement exists in lieu of federal listing (U.S. Fish and Wildlife Service 1997b).

We surveyed localities on the east and west sides of the Huachuca Mountains including those in the San Pedro River, San Rafael Valley, and Canelo Hills (Figure 1). All sites are located on 7.5 minute U.S. Geological Survey quadrangles formed by the 4 x 4 grid which has corner quads represented by Bob Thompson Peak, Fairbank, Elgin, and Lochiel. We surveyed localities across Chihuahuan desertscrub, semidesert grassland, Madrean evergreen woodland, and Madrean montane forest biotic communities (Brown 1994a, Brown 1994b, Brown 1994c, Pase and Brown 1994). Most sites we surveyed were located in semidesert grassland and Madrean evergreen woodland. Small streams occur throughout the mountain range; on the Fort they are found in Garden and Huachuca canyons. These aquatic systems consist of runs, riffles, and pools with well-developed riparian vegetation separated by reaches of intermittent flow and xeroriparian vegetation. Other aquatic systems found in the Huachuca Mountains include springs, seeps, and cienegas, many of which have been altered or destroyed. Those that remain in a natural to semi-natural state are few and scattered.

Human-constructed waters in the Huachuca Mountains are many and diverse. They fall into two major categories: 1) catchments that collect surface runoff in intermittent drainages and 2) excavated springs or basins that have water piped in. Excavated springs and basins that have

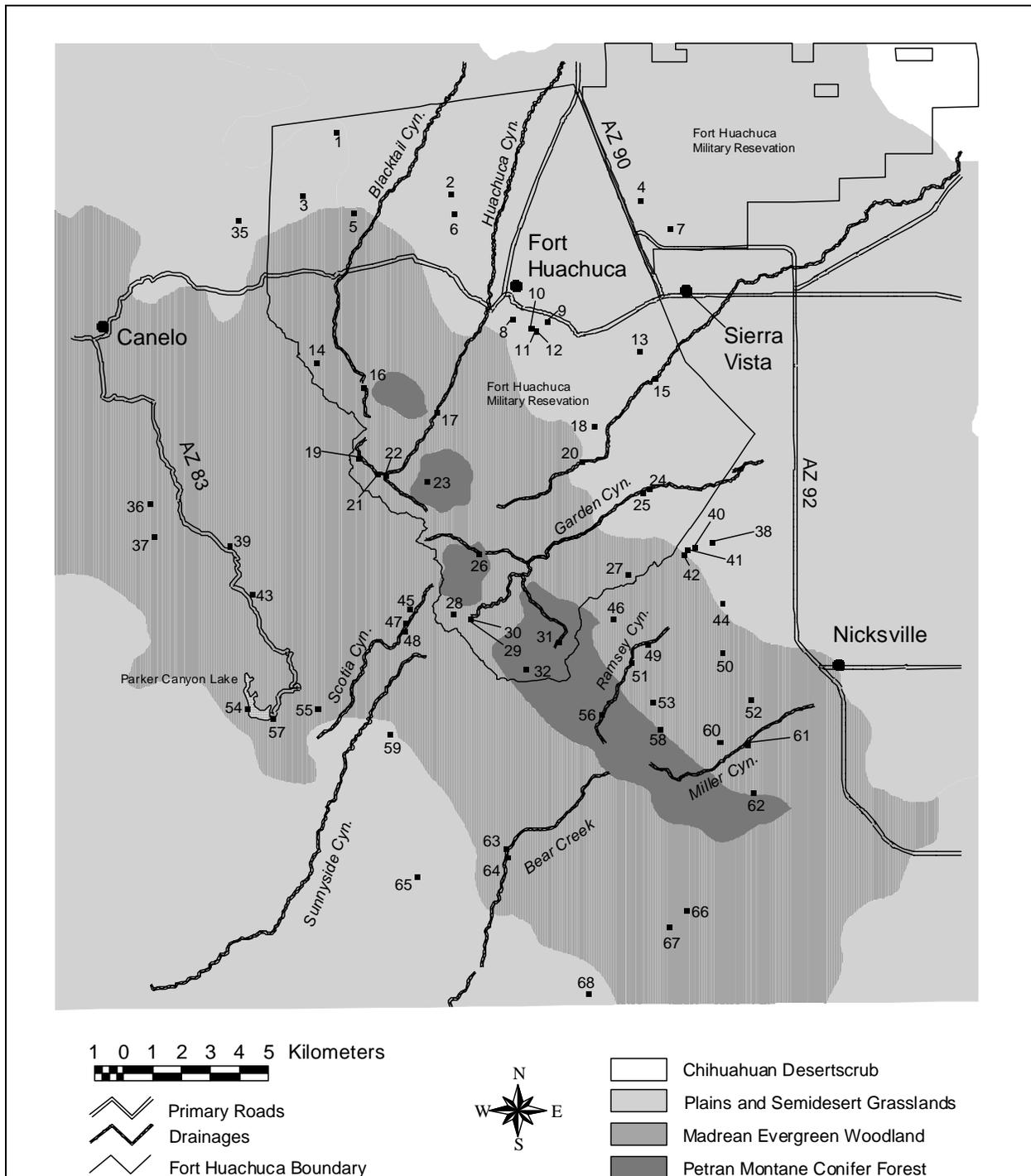


Figure 1. Sites surveyed for amphibians and semi-aquatic reptiles during 1995-1998, Huachuca Mountains region, Arizona. (See Insert 1 for site names. Sites 33 and 34 are not mapped.). (Note: Petran montane conifer forest was previously called Madrean montane conifer forest.)

water piped in are more dependable and manageable than are catchments that depend on run-off.

We searched museum collections and the literature, both peer-reviewed and gray literature reports, for records of target species (Miera and others 2000). Museums queried include Arizona State University, University of Arizona, Northern Arizona University, Museum of Northern Arizona, University of Michigan Museum of Zoology, and American Museum of Natural History. Additionally, individuals knowledgeable in the regional herpetofauna were contacted regarding unpublished observations or potential habitats. Historical records have been incorporated into the Riparian Herpetofauna Database of the Amphibians and Reptiles Program, Nongame Branch, Arizona Game and Fish Department (Arizona Game and Fish Department 2000).

Surveys were initiated in the summer of 1995, and completed during the fall of 1998. We visited sites throughout the year, but most visits were between April and October. Inventory of explosive summer breeding species was concentrated during the summer rainy season. We primarily used visual encounter surveys (VES)(Crump and Scott 1994 as modified by Sredl and others 1997) to detect presence or relative abundance of native herpetofauna and their predators. Approaching a site, we used binoculars to search for and detect their presence. Next, we searched the perimeter of lentic habitats or banks of lotic systems for additional animals. From the shore, we used long-handled dipnets to sweep vegetation to flush individuals that did not respond to our initial approach. After the perimeter survey, we searched mud cracks and deep hoof prints. Artificial lights were used for nighttime VES. Counts included visual observations and unambiguous audible sounds of target herpetofauna. Whenever possible, animals were captured, positively identified to species, photographed, and released. A few specimens were retained as vouchers if the population was sufficiently large or specimen identification ambiguous. If animals were not captured or positively identified to species, we assigned an “uncertain” code to that observation.

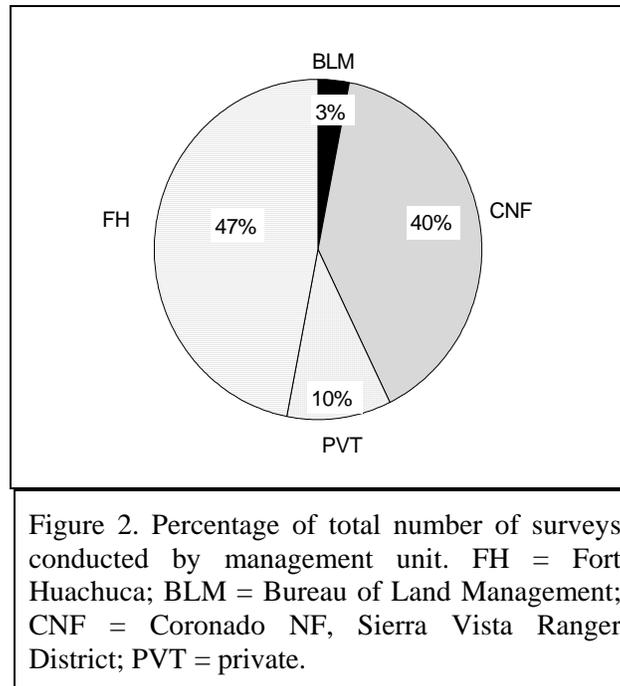
In addition to counts, we recorded time, date, air and water temperature, pH, conductivity, and relative humidity. We also measured habitat characteristics, including water clarity (scale of 1-5), percentage of vegetational categories (submergent, emergent, perimeter, floating, canopy) and substrate (silt, sand, gravel, cobble). Local weather conditions (cloud cover, precipitation, wind velocity) and relative abundance of potential vertebrate and invertebrate predators were also noted. Most habitats surveyed were also photographed.

We opportunistically used other survey techniques to increase our chance of detecting other herpetofauna species. We used night driving and call surveys, especially during the summer rains, to sample for amphibians moving to or from breeding sites. Call surveys were conducted after sunset and consisted of listening for calling males for approximately 7-15 minutes. If no males were heard, a prerecorded vocalization of this species (~5-10 calls) was broadcast across the survey area in an attempt to elicit a response. We used call surveys to detect barking frogs and Huachuca treefrogs. Call surveys and night driving were concentrated during the early the summer rainy period (late June through July).

We conducted nighttime calling surveys primarily along the north end of the mountain range on the Fort. This included a ridgeline transect to the east and above Pyeatt Cave and Manila Mine

(conducted twice) and several survey points in Blacktail Canyon in the vicinity of Deer Spring (also, conducted twice). We also surveyed marginal habitat in Garden Canyon.

Seines and small minnow traps were used to sample amphibian larvae, and baited hoop-traps were set to sample aquatic turtles. In addition to our fieldwork, we conducted two instructional workshops for land managers on various aspects of the region's riparian herpetofauna (Appendix 1-3).



To protect sensitive amphibian and reptile populations, we refer to sites using numerals, and do not provide map names or other site-specific locality data. For a key to site numbers, map names, and site-specific locality data, contact the Nongame Branch, Arizona Game and Fish Department and request Insert 1 for technical report 167.

## RESULTS

### GENERAL SURVEY SUMMARY

Within the study area, we surveyed 68 sites on 213 occasions. Thirty-two sites on the Fort were surveyed 128 times. Seventy-nine of these visits were conducted at 5 sites. Our focus on these 5 sites can be attributed to monitoring target species (e.g. 41 surveys at site 27) or removing non-native organisms (e.g. 13 surveys at site 24). The remaining localities we surveyed were located on Coronado National Forest, Sierra Vista Ranger District (n = 27), private (n = 7), or Bureau of Land Management (n = 2) property. Most localities were on the Fort or Coronado National Forest, the two largest landowners in the area. Localities in the San Pedro River corridor, which

is managed by Bureau of Land Management, represent a smaller proportion of sites we surveyed (Figure 2).

The majority of surveys occurred in 1996, the first full field season of the project. The number of surveys during 1997 and 1998 were somewhat similar (Table 2), and concentrated on localities with known extant populations of target species or areas of active conservation and management (e.g. site 27). We also focussed our efforts during the summer monsoon (July through September)(Table 2), when most amphibians are active. Late fall through early winter (December and January) is the period of lowest amphibian activity, and no surveys were conducted during this time.

We surveyed 45 lentic sites (still-water habitats) 180 times, and 23 lotic sites (flowing-water habitats) 33 times. During our surveys, we observed 14 species from 8 families of riparian herpetofauna. We observed more amphibians, 10 species (2 non-native) from 6 families, than reptiles, 4 species (1 non-native) from 2 families. On Fort Huachuca, we observed 9 amphibians (1 non-native) and 4 semi-aquatic reptiles (1 non-native)(Table 3). Using data gathered from our surveys and the literature, we created a checklist of amphibians for the Huachuca Mountains (Appendix 4).

#### TIGER SALAMANDERS

Historical records for two subspecies, the Sonora and barred tiger salamanders, are known from the study area (Ziembra and others 1998, Collins 1996). We observed tiger salamanders at four localities. One site occurred on Fort Huachuca (site 28) and 3 sites were on Coronado National Forest (sites 43, 48, and 55). All 4 sites were artificial impounded tanks, 3 were ephemeral. These sites ranged in elevation from 1714 to 1920 m. Sites where we found salamanders lie either at the northeastern edge of the known range of the Sonora tiger salamander in the San Rafael Valley or on the eastern slopes of the Huachuca Mountains, which is outside of the known range of this subspecies. Results of genetic analyses of specimens from two of these localities were either ambiguous (site 28) or consistent with barred tiger salamanders (site 43). The phylogenetic relationship of two sites (sites 48 and 55) has not been examined (Ziembra and others 1998). Non-native species were observed at two sites supporting salamanders. At site 28, we observed crayfish (*Orconectes virilis*) and at site 48, bullfrogs (*Rana catesbeiana*).

#### BARKING FROGS

The only barking frog locality in the Huachuca Mountains is located outside the boundaries of the Fort. We surveyed canyons along the eastern slopes on Coronado National Forest with Tom Deecken (USFS) and Barb Alberti (Coronado National Memorial), and discovered calling males at 2 new localities, Ash and Stump canyons. Our efforts extend the range of this species approximately 4.0 km north. In 1998, we surveyed on Post along the north end of the mountain range in areas with geology and vegetation similar to known barking frog localities. These surveys included a ridgeline transect to the east and above Pyeatt Cave and Manila Mine

(surveyed two times) and localities in Blacktail Canyon in the vicinity of Deer Spring (surveyed two times). We also surveyed Garden Canyon in marginal habitat near the end of the breeding season. Although we conducted our surveys at a time when barking frogs were calling elsewhere in the range (Alberti pers. comm.), we did not observe or hear this species on Fort Huachuca.

HUACHUCA TREEFROGS

Huachuca treefrogs were found at 4 localities in the vicinity of the Huachuca Mountains. Two sites were within the boundaries of Fort Huachuca (sites 19 and 30), in Huachuca and

Table 2. Number of aquatic herpetofauna surveys conducted between 1995-1998 in the Huachuca Mountains region, Arizona. Numbers of surveys on Fort are presented first, followed by total number of surveys in parentheses for each category.

Year	Number of Surveys				
	Total	Winter (Jan-Mar)	Spring (Apr-Jun)	Summer (Jul-Sep)	Autumn (Oct-Dec)
1995*	16(26)	0(0)	0(0)	11(20)	5(6)
1996	52(98)	19(34)	7(20)	17(33)	9(11)
1997	34(48)	4(5)	10(12)	15(24)	5(7)
1998	26(41)	0(0)	3(5)	20(26)	3(10)
<b>Total</b>	128(213)	23(39)	20(37)	63(103)	22(34)

\*partial survey year.

Garden canyons, respectively. These two localities were previously unknown or unverified. The other two sites were located on Coronado National Forest along the western slopes (sites 43 and 55). All four sites are artificial impoundments that fill with water seasonally and range in elevation from 1714 to 2019 m. We also surveyed several other high elevation aquatic systems in on Fort (e.g. Scheelite and Huachuca canyons and Cave Spring), but failed to locate any new localities. Huachuca treefrogs were found to co-occur with non-native crayfish and an occasional bullfrog (sites 30 and 55).

LEOPARD FROGS

Because of changes in taxonomy and morphological similarity, clarifying the historical ranges of the region's leopard frogs is difficult, and interpretation of historical records must be done cautiously.

Chiricahua Leopard Frogs

We did not find any Chiricahua leopard frogs during our surveys. While historical records exist for Chiricahua leopard frogs along the southwestern side of the Huachuca Mountains (Holm and Lowe 1995), this species has not been observed in the range since 1981. The closest extant

populations of which we are aware are in the San Rafael Valley, just west of our study area (Collins pers. comm.).

Table 3. List of amphibians and semi-aquatic reptiles found on and off Fort Huachuca during 1995-1998 surveys of the Huachuca Mountains.			
Common Name	Scientific Name	On Fort	Off Fort
<b>Order Caudata</b>			
<b>Family Ambystomatidae</b>			
* Sonora tiger salamander	<i>Ambystoma tigrinum stebbinsi.</i>	4	4
barred tiger salamander ‡	<i>Ambystoma tigrinum mavortium</i>	4	
<b>Order Anura</b>			
<b>Family Pelobatidae</b>			
Couch's spadefoot	<i>Scaphiopus couchi</i>	4	4
New Mexico spadefoot	<i>Spea multiplicata</i>	4	4
<b>Family Leptodactylidae</b>			
* barking frog	<i>Eleutherodactylus augusti</i>		4
<b>Family Bufonidae</b>			
red-spotted toad	<i>Bufo punctatus</i>	4	
Woodhouse's toad	<i>Bufo woodhousii</i>	4	
<b>Family Hylidae</b>			
canyon treefrog	<i>Hyla arenicolor</i>		4
* Huachuca treefrog	<i>Hyla wrightorum</i>	4	4
<b>Family Ranidae</b>			
* Ramsey Canyon leopard frog †	<i>Rana subaquavocalis</i>	4	4
bullfrog ‡	<i>Rana catesbeiana</i>	4	4
<b>Order Testudines</b>			
<b>Family Kinosternidae</b>			
Sonoran mud turtle	<i>Kinosternon sonoriense</i>	4	4
<b>Order Squamata</b>			
<b>Family Colubridae</b>			
* Mexican garter snake	<i>Thamnophis eques</i>		4
blackneck garter snake	<i>Thamnophis cyrtopsis</i>	4	
diamondback water snake ‡	<i>Nerodia rhombifer</i>	4	

\* Target species

† Any historical records assigned to the *Rana pipiens* complex from the eastern flanks of the Huachucas are assumed to be *Rana subaquavocalis*.

‡ Not native to Arizona

### Ramsey Canyon Leopard Frogs

We observed Ramsey Canyon leopard frogs at 8 localities in the Huachuca Mountains (sites 27, 38, 41, 42, 44, 46, 49, and 51). These sites are located in Tinker, Brown and Ramsey canyons. One locality (site 27) is on Fort Huachuca, 4 localities were on private property (sites 38, 44, 49,

and 51) and 3 were on Coronado National Forest (sites 41, 42, and 46). Sixty-six surveys were conducted at these eight sites. Elevation at these localities ranged from 1501 to 1829 m.

At all sites, except for one, Ramsey Canyon leopard frogs inhabit artificial water impoundments. These include earthen tanks, cement-lined ponds, and an abandoned mine pit. We also observed recently metamorphosed Ramsey Canyon leopard frogs one time in an above-ground livestock watering trough below site 46 and at several different times in temporary rain pools below site 27. Except for the rain pools, all localities are sources of perennial water or are maintained as such. Site 41 dried during the drought of 1996 and, if water had not been trucked, site 27 would have also dried. Frogs have also been observed in two ponds on The Nature Conservancy Preserve (sites 49 and 51), immediately adjacent to a natural flowing creek.

The one natural habitat supporting Ramsey Canyon leopard frogs (site 46) is a tinaja at the base of a 4.6 m waterfall. Dimensions of the tank are approximately 6 x 4 m with a depth ranging from 0.2-1.6 m. One edge of the pool has a deeply undercut rock ledge, and there is little aquatic vegetation present except algae. Counts of 1 to 3 large, adult frogs were made at this site, but no signs of reproduction were observed during the study period. Tadpoles were last noted in this canyon in 1991 (Wood 1991).

All but one Ramsey Canyon leopard frog sites have been free of non-native organisms. One bullfrog and 16 catfish were observed at site 27, but were removed before their populations could become established.

Historical records of leopard frogs that may have been Ramsey Canyon leopard frogs exist from Carr (Wright and Wright 1949), Miller (Beatty pers. comm.), Hunter (Beatty pers. comm.), Ash (Slevin 1928), and Garden canyons (Belfit unpublished data). We surveyed all of these sites except Ash, but did not observe any leopard frogs.

#### Lowland Leopard Frogs

We found no lowland leopard frogs at a locality near the San Pedro River that had supported this species as recently as 1991 (site 34, AGFD unpubl. data). Lowland leopard frogs also occurred historically along the Babocomari and San Pedro rivers (Platz and Frost 1984).

#### MEXICAN GARTER SNAKES

We observed 1 Mexican garter snake in the study area (site 42). Historical records for Mexican garter snakes exist from all three major drainages (Santa Cruz, Babocomari, and San Pedro rivers) and some of their tributaries (Rosen and Schwalbe 1988). At least two records exist from Fort Huachuca, one in a tank in the grasslands above the Babocomari River (Rosen and Schwalbe 1988), the other from the "immediate vicinity of fort" (Lowe and Schwalbe 1980). We found introduced species at most of the sites where Mexican garter snakes historically occurred.

#### NON-TARGET SPECIES

During the study period, 5 species of non-target amphibians were observed on and off Fort (Table 3). These include Couch's spadefoots (*Scaphiopus couchi*), New Mexico spadefoots (*Spea multiplicata*), Woodhouse's toads (*Bufo woodhousii*), red-spotted toads (*B. punctatus*), and canyon treefrogs (*Hyla arenicolor*). While we made no observations of green (*B. debilis*), Sonoran Desert (*B. alvarius*), or Great Plains (*B. cognatus*) toads during our study, they likely occur in the area (cited in Wright and Wright 1949, Lowe and Schwalbe 1980).

We observed 2 species of native semi-aquatic reptiles on and off Fort during the study period (Table 3): blackneck garter snakes (*Thamnophis cyrtopsis*) and Sonoran mud turtles (*Kinosternon sonoriense*).

#### NON-NATIVE SPECIES

Non-native species were observed at 32% of surveyed localities (n = 22) and 11 of these were on Fort Huachuca. Of the sites on Fort, 10 are artificial lentic waters, 7 of which are perennial. The single lotic system on Fort supporting introduced species is perennial. The most commonly encountered non-native species were crayfish, bullfrogs, and non-native sportfish. In addition to site 28 on Fort, many canyons in the Huachuca Mountains contain crayfish, including sites 54, 57, 63, and 64. Bullfrogs were found in seven localities on Fort (sites 8, 13, 18, 20, 24, 25, and 27). Off Fort they were abundant in ponds in Scotia Canyon (sites 45, 47, and 48), and found in lower densities in nearby canyons and ponds. Different non-native species often occurred together. For example, sport fish (e.g. centrarchids and catfish) were observed with either bullfrogs or crayfish at 8 sites on the Fort. There was 1 site with only bullfrogs and 2 sites with only crayfish.

In general, we found non-native aquatic organisms to be particularly prevalent in the large streams, rivers, and lakes of the study area. Crayfish were abundant throughout Garden Canyon and its confluence with the San Pedro River was densely populated with bullfrog larvae and centrarchid fishes. The Babocomari and San Pedro rivers and Parker Canyon Lake also contained many species of introduced sport fish, crayfish, and bullfrogs (Weedman pers. comm., Weedman and others 1996).

In addition to the non-native species commonly encountered, a diamondback water snake (*Nerodia rhombifera*) and red-eared slider (*Trachemys scripta elegans*) (Tuegel pers. comm.) were captured at site 18. These last two observations were likely "released pets" and not part of an established population.

#### DISCUSSION

Previous herpetofaunal inventories on Fort Huachuca concentrated on terrestrial reptiles. The status, distribution, and natural history of aquatic and semi-aquatic herpetofauna were unclear.

Our study contributes to the understanding of trends in the region's herpetofauna, by providing a baseline for aquatic herpetofauna on Fort Huachuca and vicinity. Our surveys preliminarily suggest that populations of target herpetofauna occur in small, isolated aquatic sites. In most cases, habitable aquatic systems are either remnants of historically larger perennial aquatic systems that have now contracted (see Hendrickson and Minckley 1984) or peripheral to larger aquatic systems (large lake, stream, or river) which presumably hosted a large source populations. The relationship of these "core-periphery populations" is likely similar for many amphibians and other species of aquatic wildlife. With non-native species dominating the remaining aquatic habitats, habitat for native herpetofauna is reduced to small, isolated pockets that are capable of supporting only small, unstable populations. The precarious state of habitats that support these species has created a critical need to develop general land management plans and species-specific conservation plans for many species of aquatic and semi-aquatic wildlife.

Sredl and others (1997) argue that native leopard frogs are distributed as metapopulations (a group of populations connected by dispersal corridors), and that population declines among southwestern leopard frogs can, at least in part, be attributed to disruption of normal metapopulation dynamics by various human disturbances. These disturbances have caused an increase in rates of extinction and a decrease in rates of recolonization. With the exception of lowland leopard frog populations in central Arizona, many southwestern leopard frog populations have apparently declined, some dramatically (Sredl and others 1997). Resources agencies, wildlife managers, and those interested in conservation of leopard frogs and other aquatic herpetofauna need to intensify their efforts to develop sound approaches to local conservation, if the future viability of this group is to be assured. Data collected under this project has been incorporated into the conservation planning for Ramsey Canyon leopard frogs, and will be reported by the Ramsey Canyon Leopard Frog Conservation Team. In addition to contributing to local conservation planning, information we gathered on target species (and to a lesser degree, non-target species) and their habitats will provide a firm cornerstone to sound land management (for management recommendations, see Sredl and Wallace 2000).

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#### APPENDIX 1. EDUCATIONAL WORKSHOPS

Two instructional workshops were conducted for land managers from various government agencies on regional riparian herpetofaunal issues. The workshops began with a treatment of identification, distribution, status, and natural history of species found in southeastern Arizona (with focus on the Huachucas). This was followed by a discussion on the conservation and management of amphibian species of concern, with special focus on the impact of non-native species. A field trip to view amphibians and their habitat concluded the workshop. More than 30 individuals attended the two workshops, representing U.S. Fish and Wildlife Service, Coronado National Forest, Bureau of Land Management, Arizona Game and Fish Department, Fort Huachuca, and The Nature Conservancy. The following materials provide additional information on these workshops.

APPENDIX 2. INVITATION TO OCTOBER 22, 1998 WORKSHOP.



THE STATE OF ARIZONA

**GAME & FISH DEPARTMENT**

2221 West Greenway Road, Phoenix, Arizona 85023-4399 (602) 942-3000  
www.gf.state.az.us

**Governor**  
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Steve K. Ferrell

MEMORANDUM

**TO:** Interested Parties  
**FROM:** Eric Wallace  
Amphibians and Reptiles Biologist  
**SUBJECT:** A Workshop on Aquatic and Semi-aquatic Herpetofauna of the  
Huachuca Mountains and Surrounding Region  
**DATE:** September 28, 1998

I would like to invite you to a workshop on the aquatic and semi-aquatic amphibians and reptiles of the Huachuca Mountains and surrounding area (general application to all of southeastern Arizona). It will be held at the Coronado National Forest, Sierra Vista District Office on October 22, 1998, from 9:00 a.m. - 5:00 p.m.

The primary objective of the workshop will be educating the audience in field identification techniques. In addition, individual species coverage will include information on life histories, habitat requirements, and conservation and management needs. The impact of nonnative introduced aquatic species will also be a topic of discussion.

Often, occurrence records of these species come to us through incidental observations by field-based agency personnel. It is my intent that this workshop function to stimulate interest in and refine field identification skills. By doing so, we increase the number of qualified personnel available to record their distribution.

Please reply as soon as possible so I can begin planning for the number of individuals who will be attending. If you know of others in your work unit, who would benefit from this workshop, please let me know. Attendance is limited, but I will fill vacancies as they open up. Additionally, if you are unable to attend for some reason but are interested in this workshop, please let me know for future reference.

Please contact me at (602) 789-3377 or [cwallace@gf.state.az.us](mailto:cwallace@gf.state.az.us) if you have any questions.

JEW:jw

cc: Mike Sredl

Enclosure

APPENDIX 3. AGENDA FOR OCTOBER 22, 1998 WORKSHOP.

**Workshop: Aquatic and Semi-Aquatic Amphibians and Reptiles  
of the Huachuca Mountains and Surrounding Area**

**October 22, 1998**

**Coronado National Forest  
Sierra Vista District Office**

**5990 South Highway 92**

**Hereford, AZ**

**(520) 378-0311**

**Tentative Schedule:**

**9:00 a.m. - 11:30 a.m.**

- \* Introduction
- \* Individual Species Accounts
- \* Conservation and Management
- \* Non-native Introduced Species

**11:30 a.m. - 12:30 p.m.**

- \* Lunch (bring your own or visit nearby restaurants)

**12:30 p.m. - 2:00 p.m.**

- \* Wet Lab
  - Identification using preserved specimens

**2:00 p.m. - 5:00 p.m.**

- \* Field Trip to Fort Huachuca (**wear proper attire**)
  - Field survey techniques
  - Live specimens (if present and cooperative)
  - Visit different habitat types

APPENDIX 4. CHECKLIST OF FORT HUACHUCA AMPHIBIANS

Checklist of amphibians known to occur in the vicinity of the Huachuca Mountains.

Common Name	Scientific Name
<b>Order Caudata</b>	
<b>Family Ambystomatidae</b>	
* Sonora tiger salamander	<i>Ambystoma tigrinum stebbinsi.</i>
barred tiger salamander ‡	<i>Ambystoma tigrinum mavortium</i>
<b>Order Anura</b>	
<b>Family Pelobatidae</b>	
Couch's spadefoot	<i>Scaphiopus couchi</i>
New Mexico spadefoot	<i>Spea multiplicata</i>
<b>Family Leptodactylidae</b>	
barking frog	<i>Eleutherodactylus augusti</i>
<b>Family Bufonidae</b>	
Sonoran Desert toad	<i>Bufo alvarius</i>
Great Plains toad	<i>Bufo cognatus</i>
green toad	<i>Bufo debilis</i>
red-spotted toad	<i>Bufo punctatus</i>
Woodhouse's toad	<i>Bufo woodhousii</i>
<b>Family Hylidae</b>	
canyon treefrog	<i>Hyla arenicolor</i>
Huachuca treefrog	<i>Hyla wrightorum</i>
<b>Family Ranidae</b>	
Chiricahua leopard frog	<i>Rana chiricahuensis</i>
Ramsey Canyon leopard frog †	<i>Rana subaquavocalis</i>
lowland leopard frog	<i>Rana yavapaiensis</i>
bullfrog ‡	<i>Rana catesbeiana</i>

† Historical *Rana pipiens* records from the eastern side of the Huachuca Mountains are assumed to be *Rana subaquavocalis*.

‡ Introduced species

Insert 1: Site Number - Name Key for Sredl, M.J., J.E. Wallace, and V. Miera. 2000. Aquatic herpetofauna inventory of Fort Huachuca and vicinity. Nongame and Endangered Wildlife Program Technical Report 167. Arizona Game and Fish Department, Phoenix, Arizona.

Site names and coordinates of herpetofauna survey localities during 1995-1998, Huachuca Mountains, Arizona. ID # refers to Figure 1; UTM-E and UTM-N are Universal Trans-Mercator coordinates as measured from USGS 7.5' quadrangles. Elevation is given in meters, and NGB# is the unique AGFD Nongame Branch Amphibian Program database number given to each site.

ID #	Site	SiteAt	UTM-E	UTM-N	Elev	NGB #
1	Antelope Pond	Fort Huachuca	554720	3496760	1417	MIL-0027
2	Slaughterhouse Pond	Fort Huachuca	558640	3494620	1417	MIL-0026
3	Sycamore Pond	Fort Huachuca	553550	3494560	1455	MIL-0019
4	Effluent Ponds	-	565220	3494400	1372	MIL-0028
5	Hidden Pond	Fort Huachuca	555320	3493980	1494	MIL-0021
6	Buffalo Spring Tank	1.6 km N of Demonstration Hill	558780	3493920	1433	MIL-0008
7	Unnamed Pond	N of Sierra Vista	566220	3493420	1381	MIL-0036
8	Officer's Club Pond	Fort Huachuca	560800	3490280	1509	MIL-0017
9	Fly Pond	Fort Huachuca	561980	3490200	1478	MIL-0018
10	Soldier Creek	Wildlife office	561440	3490000	1494	MIL-0020
11	Unmarked Pond	SW of Ft Huachuca Wildlife office	561610	3489920	1478	MIL-0034
12	Unmarked Pond	SW of Ft. Huachuca Wildlife office	561610	3489880	1478	MIL-0033
13	Golf Course Pond	Fort Huachuca	565160	3489160	1448	MIL-0014
14	Deer Spring	-	554020	3488800	1890	MIL-0012
15	Unnamed/Unmarked Tanks	NE of Ft. Huachuca Gravel Pits	565710	3488250	1448	MIL-0025
16	Blacktail Pond	S. of Blacktail Spr.	555660	3487950	2042	MIL-0011
17	Huachuca Canyon	-	558180	3487060	1707	MIL-0023
18	Gravel Pit Ponds	Fort Huachuca	563640	3486600	1509	MIL-0016
19	Unmarked Tank	Unnamed Trib of Upper Huachuca Canyon	555500	3485500	2019	MIL-0035
20	Woodcutters Pond	Fort Huachuca	563200	3485380	1554	MIL-0015
21	Unnamed Tributary	Huachuca Canyon	556120	3484940	1920	MIL-0032
22	Unmarked Tank	Confl Huachuca Canyon & Unnamed Trib	556420	3484880	1875	MIL-0030
23	Unnamed Trib of Huachuca Cyn	Nw of Huachuca Peak	557830	3484660	1798	MIL-0031
24	Lower Garden Cyn Pond	E of Antelope Run Rd And Garden Cyn Jct	565500	3484400	1494	MIL-0002
25	Middle Garden Cyn Pond	W of Antelope Run Rd And Garden Cyn Jct	565300	3484300	1501	MIL-0001
26	Mcclure Spring	-	559640	3482180	1798	MIL-0004
27	Tinker Pond	Tinker Canyon	564780	3481450	1631	MIL-0009
28	Upper Garden Canyon Pond	Upper Garden Canyon	558740	3480100	1920	MIL-0024
29	Garden Canyon	Sawmill Canyon	559330	3479920	1890	MIL-0005
30	Boy Scout Cabin	Sawmill/Garden Canyon Confl	559320	3479900	1890	MIL-0029
31	Scheelite Canyon Pools	~3.2 km Up Cyn From Confl W/Garden Cyn	562400	3479130	2164	MIL-0022
32	Sawmill Spring	-	561280	3478200	2164	MIL-0007
33	San Pedro River	Hwy 82	576420	3509840	1174	BLM-0014
34	Lewis Springs	-	581470	3494180	1234	BLM-0040
35	Unnamed Tank	N of Pyeatt Ranch	551350	3493720	1494	COR-0189
36	Unnamed Tank	Se Pauline Well	548280	3483900	1608	COR-0195
37	Unnamed Tank	Nw of FS 201/Hwy 83 Jct	548420	3482780	1669	COR-0084
38	Bernstein Cement Fish Pond	NE Barchas Ranch	567700	3482560	1501	PVT-0242
39	Unnamed Tank	W of Joiner Camp	551020	3482460	1654	COR-0194
40	Unnamed Tank	NE of Barchas Ranch	567080	3482400	1509	COR-0230
41	Wild Duck Pond	NE Barchas Ranch House	566820	3482300	1516	COR-0244
42	House Pond	Barchas Ranch House	566700	3482160	1524	COR-0245
43	Unnamed Tank	N of Parker Canyon Lake	551790	3480790	1728	COR-0182
44	Unmarked Mine Pit	W of Richards Ranch	568040	3480480	1539	PVT-0237
45	Unnamed Tanks	Peterson Ranch	557260	3480250	1882	PVT-0092

46	Brown Canyon	1615 to 1768 m	564280	3479920	1768	COR-0190
47	Unnamed Tank	SW of Peterson Ranch	557100	3479800	1847	PVT-0203
48	Unmarked Tank	Scotia Canyon	557050	3479480	1814	PVT-0201
49	Concrete Orchard Pond	Ramsey Canyon Preserve	565450	3479060	1719	PVT-0230
50	Carr Canyon	Carr Canyon Ranch	568020	3478750	1646	COR-0069
51	Renovated Trout Pond	Ramsey Canyon	564900	3478400	1829	PVT-0232
52	Clark Spring	-	569020	3477120	1844	COR-0210
53	Unnamed Spring	Upper Carr Canyon	565640	3477040	2195	COR-0207
54	Parker Canyon	Below Parker Canyon Lake Spillway	551620	3476850	1638	COR-0228
55	Unnamed Tank	E of Parker Canyon Lake	554050	3476840	1715	COR-0191
56	Pat Scott Canyon	Wisconsin Canyon Confluence	563880	3476600	2012	COR-0256
57	Parker Canyon Lake	Boat Launch And Store	552510	3476480	1646	COR-0083
58	Unnamed Spring	W of Ramsey Vista	565880	3476090	2195	COR-0208
59	Unmarked Tank	SSE of Sunnyside Cemetery	556540	3475950	1798	COR-0055
60	Unnamed Trib of Miller Cyn	Beatty's Orchard	567940	3475660	1951	COR-0233
61	Miller Canyon	End of Miller Canyon Rd	568900	3475610	1737	COR-0071
62	Hunter Spring	-	569100	3473940	1920	COR-0234
63	Unnamed Tributary	Lone Mountain Canyon	560600	3472000	1737	COR-0211
64	Bear Creek	FS 61	560630	3471690	1676	COR-0072
65	Double Tanks	FS 61/Joaquin Creek Crossing	557500	3471000	1646	COR-0212
66	Oak Spring	-	566800	3469860	1890	COR-0057
67	Unmarked Tank	-	566190	3469300	1765	COR-0192
68	Unnamed Tank	-	563420	3467000	1631	COR-0193