

**Long-term monitoring of Amphibians and Reptiles at Saguaro National Park,
Tucson Mountain District, Pima County, Arizona**

Report of Results, 2003-2008



Sidewinder (*Crotalus cerastes*) in Saguaro National Park, Tucson Mountain District. D. Prival photo.

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Saguaro National Park

Introduction

Saguaro National Park is well-known for its diversity of reptiles and amphibians, which includes a number of unique species not found in any other park on the United States. The park is located in southeastern Arizona on the edge of the Sonoran and Chihuahuan Deserts, yet also includes many upland species associated with the Rocky Mountains and the Madrean Mountains of Mexico.

The herpetofauna of the two districts present a fascinating study in biogeography. At least 37 species have been documented in the park's Tucson Mountain District (Flesch et al. 2007), which is lower, drier, and further west than the Rincon Mountain District. Like RMD, TMD's reptile community includes well-known desert species such as Gila monster (*Heloderma suspectum*), Couch's spadefoot toads (*Scaphiopus couchii*) and desert tortoise (*Gopherus agassizii*). TMD does not include several species found in the Rincon Mountain District, such as Arizona Black Rattlesnake (*Crotalus cerberus*), short-horned lizard (*Phrynomoma douglassii*) and Great Plains skink (*Eumeces obsoletus*). Some of these species are only found throughout the area at high elevations, but many reach their further western or southern distributions in the Tucson area.

In contrast, TMD includes several species not found in RMD that reach their furthest western and northern distributions in the Tucson areas. For example, sidewinders and desert iguanas (*Dipsosaurus dorsalis*) are found along the western edges of TMD, but have never been recorded at RMD.

The NPS inventory of reptiles and amphibians (Flesch et al. 2007), a major effort that occurred during 2001-2002, confirmed the presence of these unique TMD species, but also identified several similar species that may occur in TMD but have not been documented. The inventory report lists the following species as occurring very close to TMD but not documented for the district:

- chuckwalla (*Sauromalus obesus*)
- western groundsnake (*Sonoran semiannulata*)
- southwestern black-headed snake (*Tantilla hobartsmithi*)
- long-tailed brush lizards (*Urosaurus graciosus*)
- desert horned lizard (*Phrynosoma platyrhinos*)
- western shovel-nosed snake (*Chionactis occipitalis*)
- spotted leaf-nosed snake (*Phyllorhynchus decurtatus*)
- saddled leaf-nosed snake (*Phyllorhynchus browni*)

One of these species, the western shovel-nosed snake is a candidate for federal listing as an endangered species. The shovel-nosed snake, like the other snakes listed above, is a rare and secretive small snake that is seldom found on the ground surface. Brown (in press) notes that the spotted leaf-nosed snake was previously documented in TMD, in 1953, although the current status is unknown.

One source of data for the NPS inventory was an array of pitfall traps and cover boards established near the western boundary of TMD in the vicinity of Sanders Road. Pitfall traps are essentially buckets that lie below the ground, with their opening at the ground surface. Used with drift fences, which are essentially aluminum sheeting pressed into the ground to form a wall leading to the trap, pitfalls are an excellent way to capture relatively uncommon reptiles and amphibians, which follow the drift fence line to the bucket, then fall into the buckets and cannot jump out. Cover boards are simply small boards (1 ft² in this case) that are laid on the desert surface. Reptiles use their shade and moisture during the heat of the day, and are exposed and captured when the boards are lifted by a researcher.

After the inventory ended in 2002, the pitfall traps were transferred to the park, which continued to use them due to their value for long-term monitoring. The major factor in the decision was that Philip Brown, a TMD interpretive employee and volunteer for the inventory, was willing to continue to maintain the pitfalls and check them daily. The objectives of this study during 2003-2008 have been the following:

1. Document rare and secretive reptile and amphibian species that may occur at TMD but have not been documented, particularly the T&E candidate species, the western shovel-nosed snake;

2. Monitor changes in herpetofauna, particularly low desert species such as desert iguanas, along TMD's sensitive western boundary as this area becomes developed;
3. Create a data set for herpetofauna, using inexpensive technology, for long-term monitoring in Saguaro National Park, which has no existing program for monitoring of herpetofauna.
4. Provide photographs and data useful for interpreting amphibians and reptiles at Saguaro National Park.

This report presents the results of this monitoring effort during 2003-2008 and presents recommendations for future monitoring at TMD.

Methods

Pitfall trapping is a live-trap, passive sampling technique useful for detecting species that are difficult to observe due to rarity, limited activity, or inconspicuous behavior (Corn 1994). The array at TMD is a standard array that contains three 19 liter buckets spaced 25 feet (7.6 m) apart at angles of approximately 120 degrees from a central bucket. Drift fences are 25 feet (7.6 m) long approximately 1 ½ feet (0.5-m) tall are made of aluminum-flashing supported by rebar. Buckets are buried with their edges at ground level, with cover boards placed on small blocks over them to keep animals cool during day (Corn 1994).

Traps are typically opened as temperatures warm in springtime (March-April) and are kept open throughout the summer until temperatures cool in October-November. Traps are checked daily, or if they cannot be checked daily they are closed with bucket lids. Traps are typically every morning at sunrise. We release the animals after recording species, sex, and age class (if known).

The trap array was located on the bajada, west of Sandario Road and south of Manville Road (UTM 477739 m E, 3571005 m N) at 700 m elevation.

In addition to the pitfall array, we recorded reptiles and amphibians observed under cover boards set out by the NPS inventory and monitoring program. Cover boards for monitoring herpetofauna are typically small pieces of plywood set out and periodically checked for animals that take shelter under them. We used approximately 10 cover boards (0.5" plywood, approximately 15" square) located near the pitfall array; these were checked every few weeks during March-October. We also recorded reptiles and amphibians observed during pitfall trapping activities, including snakes observed on the roads nearby.



Figure 1. Pitfall trap array in Saguaro National Park, Tucson Mountain District, being checked by Philip Brown. White fence is the drift fence; photo on right shows the top of the center trap, including the white cover and the brown shade structure for the trap.

Results

During 2003-July 2008, we captured 390 individuals of 15 species of amphibians and reptiles in pitfall traps (Table 1). Traps were open for xx trap-nights during this period. Number of individuals per trap night varied among years; it was highest (4.24 individuals/trap night) in 2004 and lowest (2.34 individuals/trap night) in 2003.

The species accumulation curve, or the number of total species detected as a function of the length of the study (Figure 2) continued to rise as of 2008, indicating that new species are still being detected in the area and that further pitfall trapping is likely to result in new species not previously captured.

Combining results of cover boards and observations, during 2003-2008 we observed 13 species of amphibians and reptiles (Table 2). Five of these were not captured in pitfall traps during the same period. However, four species were captured in pitfalls that were not otherwise observed.

Table 1. Overall results of pitfall trap long-term monitoring at TMD, 2003-July 2008. Results for 2008 (in *italics*) are through June only, and are not included in overall totals.

Species	Year					
	2003	2004	2005	2006	2007	2008
Desert spiny lizard	21	23	28	17	19	<i>11</i>
Western whiptail	31	8	32	21	21	<i>12</i>
Western banded gecko	5	2	4	5	3	<i>0</i>
Tree lizard	1	4	1	2	2	<i>3</i>
Desert Iguana	3	0	2	4	1	<i>3</i>
Side-blotched lizard	6	6	8	13	5	<i>0</i>
Zebra-tailed lizard	4	2	3	5	5	<i>3</i>
Couch's spadefoot	1	4	3	9	9	<i>0</i>
Western blind snake	1	0	0	0	0	<i>0</i>
Regal horned lizard	1	0	0	2	1	<i>0</i>
Sonoran Desert toad	0	1	1	2	3	<i>0</i>
Coachwhip	0	0	0	1	0	<i>0</i>
Red-spotted toad	0	0	0	0	1	<i>0</i>
Desert patch-nosed snake	0	0	0	0	1	<i>0</i>
Mojave rattlesnake	0	0	0	0	0	<i>1</i>
Total	74	50	82	81	71	<i>32</i>
No trap-days 2003-2007	173	212	194	221	215	--
Individuals/trap night 2003-2007	2.337838	4.24	2.365854	2.7284	3.0282	--

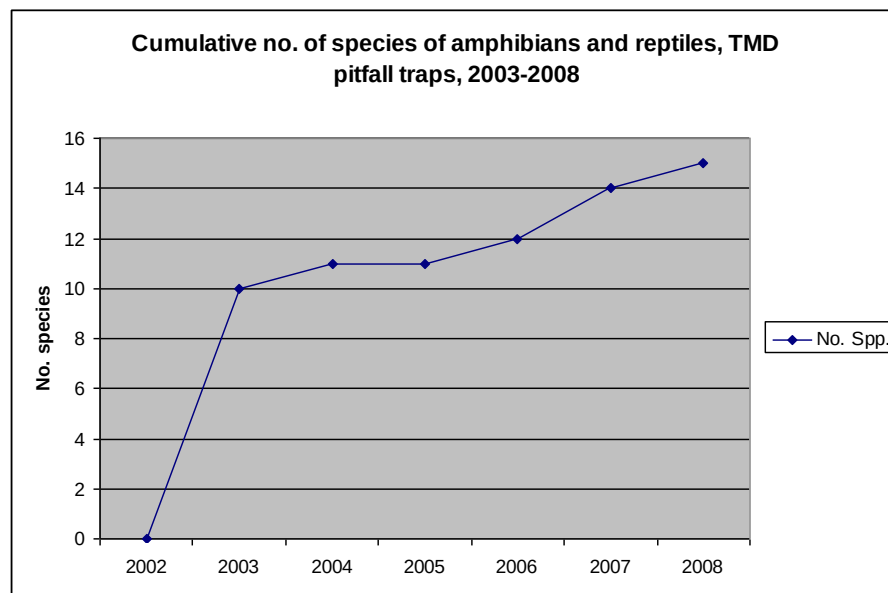


Figure 2. Species accumulation curve for pitfall traps at Saguaro National Park, Tucson Mountain District, 2003-2008. Data for 2008 not complete.

Table 2. Species observed under cover boards or while checking pitfall traps at Saguaro National Park, Tucson Mountain District, 2003-2008. Date for 2008 not complete.

Species	Year					
	2003	2004	2005	2006	2007	2008
Desert spiny lizard	0	1	1	0	0	0
Western whiptail	1	0	0	0	0	0
Western banded gecko	0	0	1	0	0	2
Desert Iguana	1	0	0	0	0	3
Side-blotched lizard	3	7	3	2	0	1
Zebra-tailed lizard	1	0	0	0	0	0
Sonoran Desert toad	1	0	0	0	0	0
Coachwhip	2	1	1	0	1	0
Desert patch-nosed snake	0	1	0	0	0	0
Long-nosed leopard lizard	0	0	0	0	0	1
Sonoran gophersnake	1	2	0	1	1	1
Long-nosed snake	0	0	1	0	0	0
Western diamond-backed rattlesnake	2	0	1	1	0	0
Total	12	14	8	4	2	8

Monitoring costs. The cost to Saguaro National Park of the inventory was relatively minimal due to Philip Brown's volunteer hours. Philip volunteered approximately 600 hours during 2003-2008, posted the results on the park's P drive (p/resources/wildlife) and periodically updated Don Swann about the effort. Don Swann reports results of the pitfall array each year to the Arizona Game and Fish Department and Philip Brown is listed on Don's AGFD permit. The trap array is very inconspicuous (we were unable to locate it for an aerial photo image using Google Earth), in an area of TMD that has no trail and receives little foot traffic, and we are not aware of any reports or questions about the array to the Visitor Center or TMD rangers.

Pitfall traps occasionally are responsible for animal deaths, usually due to predation by other animals. During the study we recorded, on average, less than one death per year in the pitfalls. However, many of the snakes observed while checking were found dead due to roadkill.

Discussion and recommendations

During 2003-2008, we detected 19 species of amphibians, including 15 in pitfall traps. We did not detect any of the rare species not detected during the 2001-2002 inventory effort (Flesch et al. 2007). However, we did capture a number of species of interest for long-term monitoring, including desert iguanas and long-nosed leopard lizards, both of which must be considered uncommon at TMD and at risk of extirpation due development in Avra Valley.

Our results are worthy of comparison with the pitfall results from the inventory of 2001-2002 (Flesch et al. 2007). During the inventory the pitfall traps were only open for 25 nights. The NPS inventory crew trapped 20 individuals of eight species, with zebra-tailed lizard and desert spiny lizard were most common. Pitfall trapping was considered inefficient in terms of number of species and total individuals detected per unit time but the inventory did not consider efficiency in terms of person-hours.

We recommend that the pitfall array continue to be used for monitoring herpetofauna for the short-term, as long as Philip Brown is willing to keep up regular checking and maintenance of the traps. The cost to the park is relatively small, and the data provided has many potential uses in long-term monitoring. The NPS inventory and monitoring program completed environmental compliance on the pitfall array and other monitoring activities when it was originally installed in 2001, and the array should be included in a future compliance process for wildlife monitoring by Saguaro National Park staff and volunteers. In the future, if Philip or another volunteer is not available to monitor the pitfalls, the park should consider working with a partner, such as a researcher at University of Arizona, to continue monitoring. If the pitfalls cannot be regularly maintained, however, they should be removed.

Ultimately, we believe that Saguaro National Park should have a program in place for long-term monitoring of the herpetofaunal community. Currently, the NPS inventory and monitoring program has not included vertebrate animals, except for birds, in long-term monitoring, and the park has staff resources only for very specific and focused monitoring, such as for saguaros (*Carnegia gigantea*) and lowland leopard frogs (*Rana yavapaiensis*). Lack of monitoring of vertebrates is mainly due to the cost of such programs, which require specialists. However, we believe that there are cost effective methods for monitoring herpetofauna that will yield important information for management on changes to the community over time. One approach is to maintain monitoring using volunteers and partners from other organizations, such as the University of Arizona or interested community groups. In addition, costs of monitoring can be reduced by sampling many areas of the park, particularly areas where any changes are likely to occur very slowly over time (such as higher elevations in both districts), at less frequent intervals.

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