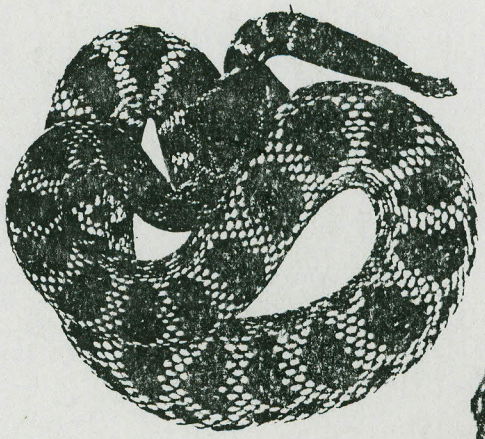
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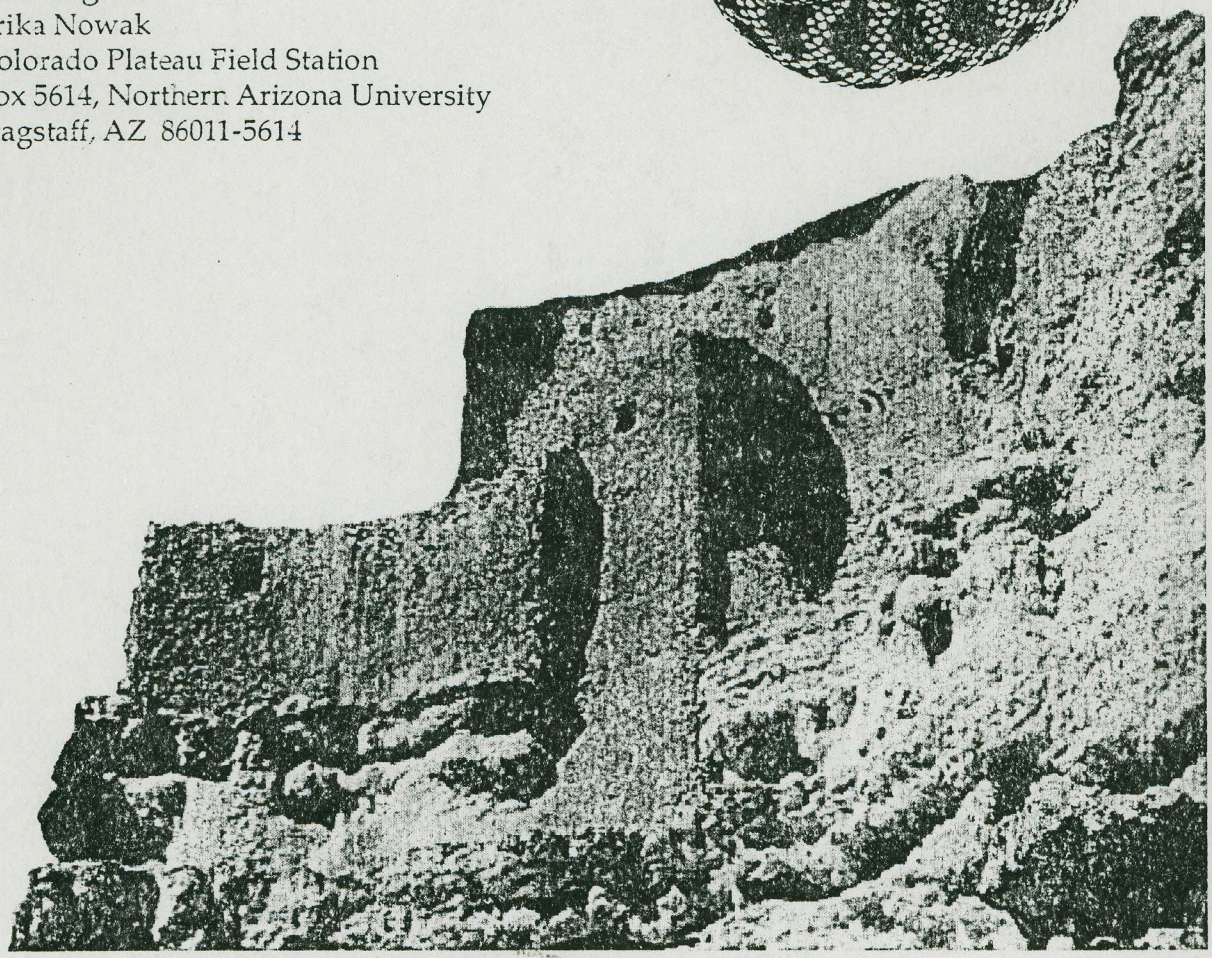
# Montezuma Castle National Monument
# Integrated Inventory and Monitoring Studies

## Amphibians and Reptiles



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# Inventory and Assessment of Amphibian and Reptile Communities at Montezuma Castle National Monument

## INTRODUCTION

The Verde Valley is one of the fastest growing areas in the Southwest. Montezuma Castle National Monument (MOCA) encompasses biological resources that are threatened by the Valley's rapid development and urbanization. Human activities both within and outside of the Monument pose a threat to these resources. The problem of external impacts is much more acute in a small unit like Montezuma Castle. The Montezuma Castle Resources Management Plan (RMP) identified several important threats and issues facing the monument, including: (1) lack of basic resource data; (2) adjacent land uses; (3) visitor use impacts; and (4) non-native species invasion.

This study was undertaken to provide data on the Monument's amphibian and reptile populations, which will help address the threats and issues listed above. In order to adequately manage and protect native plant and animal populations, the Monument needs to:

(1) know what species are present,

(2) determine species distribution, habitat affiliations and ecological requirements, and

(3) learn about the basic population biology of species occurring within the Monument.

This inventory study provides information relative to the following projects listed in the Montezuma Castle RMP:

MOCA-N-04 Identify and Inventory Water-related Resources

MOCA-N-07 Inventory the Basic Natural Resources of Montezuma Well and Adjacent Riparian and Terrestrial Habitats

MOCA-N-09 Conduct Riparian Ecosystem Research

MOCA-N-17 Conduct Inventory and Assessment: Amphibians and Reptiles

Objectives of this study were to:

1) Determine the species of amphibians and reptiles that occur within the monument;

2) Determine the distribution and abundance of amphibian and reptile species, in relation to the major habitat types present at the Monument;

3) Collect ecological information, such as habitat affiliations and requirements, seasonal patterns of habitat use, movements within and between habitats, dispersal of young, home range characteristics, growth rates, mortality, recruitment, and longevity.

4) Develop a long-term herpetological monitoring program for use by park staff, and train park staff in its use.

5) Develop an annotated checklist of the amphibians and reptiles of the monument, that can be distributed via the Monument Visitor Center.

## METHODS

### Sampling Techniques

A wide variety of amphibian and reptile species are known from the Verde Valley of central Arizona. These range from small treefrogs associated with seasonal ponds to toads adapted to relatively dry conditions; from lizards, such as the tree lizard, associated with cliffs and rock outcroppings to wide-ranging whiptail lizards associated with open areas; and from small burrowing snakes, such as the ground snake, to large, heavy-bodied sedentary snakes such as the western diamondback rattlesnake, to long, fast, agile snakes such as the coachwhip and whipsnakes. No single field sampling method can be used for this wide range of species, or for the variety of different habitats they occur in. For this reason, we used several different sampling methods for amphibians and reptiles at Montezuma Castle National Monument. These included: 1-gallon pitfall traps, arranged in linear transects; 5-gallon pitfall arrays; artificial cover boards in a variety of sizes; time-constrained searches; night driving; and wire funnel traps. Each of these methods is described in detail below. In addition, we recorded other amphibian and reptile species that were seen or captured incidental to the main sampling techniques (e.g. when we were en route to sampling areas). We also solicited observations from Montezuma Castle National Monument staff, and attempted to verify all reports that were passed along to us. Several new species were recorded by these additional observations.

### Pitfall Transects

Pitfall traps are jars, cans, or similar receptacles sunk into the ground with only the opening of the receptacle exposed at the surface [1]. We employed two styles of pitfall traps in this study. Pitfall traps set out in long transects were 4 l (1 gallon) plastic jars with 30 cm x 30 cm plywood covers over them. Pitfall traps used in arrays (see below) were 19 l (5 gallon) utility buckets with 60 cm x 60 cm plywood covers. The plywood placed over the trap of the pitfall provides ground-level cover, which attracts some species of reptiles and amphibians, as well as affording shade and cool temperatures in the trap on warm summer days. Both the small and the large pitfall traps could be securely closed when they were not in use: the small jars with screw-on lids, and the large buckets with snap-on tops.

Transects contained both pitfall traps and artificial cover boards (described below) so that we could compare the effectiveness of traps and boards. Eight pitfall / coverboard transects were sampled: six at Montezuma Castle and two at Montezuma Well. We began to deploy the transects in January 1993 and finished the last transect in June of that year. Pitfall traps were opened at the start of each trapping session by removing the jar lids and placing the wooden cover back over the trap. Traps were left open for at least four consecutive days each month during the active season for amphibians and reptiles (March through October). Except under unusual circumstances (when we were unable to get out in the field), traps were checked once per day when they were open, and all captured animals were identified, measured, and released. At the end of each monthly sampling session, traps were closed by screwing the jar lids back on to prevent unwanted captures until the next sampling session.

Transect locations, and the habitats they sample, are as follows:

1) The hilltop transect begins at the summit of the hill northwest of the Castle, runs down to a south-trending wash / gully, then follows the gully out onto a flat vegetated with creosote bush. The first (hilltop) part of the transect samples crucifixion thorn / desert grassland. The second part samples the gully itself, and the last part samples creosote bush. Transect length is 820 m.

2) The riparian transect runs through mesquite, cottonwood, and other riparian trees and shrubs, between the creek and the conspicuous band of dense mesquite west of the creek.

3) The north transect samples the open mesquite / acacia area north of the Well and the pithouse ruin. The area is relatively homogeneous, with a grass understory.

4) The picnic area transect consists of two parallel transects - one through the middle of the grassland, and one near the edge of the woods.

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[1] All sampling areas where digging was done were approved beforehand by Park Service archaeologists at WACC

### Pitfall Arrays

In addition to the pitfall traps deployed singly along transect lines, we combined groups of pitfall traps to form pitfall arrays. The pitfall arrays used in this study consist of large (19 l; 5 gallon) pitfall buckets deployed in Y-shaped groups of four (Jones 1986). A central bucket is surrounded by three other buckets located 7 m from the central bucket (Fig. 3). A 30 cm or 45 cm high fence made of metal gutter flashing runs between the center bucket and each of the surrounding buckets. This "drift fence" is sunk 3-4 cm into the ground and serves to direct passing animals to move along the fence until they reach one of the buckets. Each pitfall in the array is covered by a 60 cm x 60 cm plywood cover, similar to those used over the smaller pitfall traps.

Nine pitfall arrays were installed: six at Montezuma Castle and three at Montezuma Well. Array installation began in August 1993 and was completed in May 1994. We did not place any arrays in cliff or bedrock areas due to the impracticality of digging 5-gallon holes into rock outcrops. Each array was opened for at least four days per month during the active season by removing the snap-on lids and placing the plywood cover over the trap. As with the smaller pitfall traps, arrays were checked once per day while they were open, and all captured animals identified, measured, and released. At the end of each trapping session, the lids were put back on the buckets and secured until the next sampling period.

### Coverboards

Artificial cover primarily samples amphibian and reptile species that typically occur under rocks, logs, and other cover for either physical protection or for the moderate microclimate that the cover provides. This method has both advantages and disadvantages in comparison to pitfall traps. Because the cover object provides a microhabitat that is attractive to some species of amphibians and reptiles, it may "capture" more individuals than a pitfall trap, which relies more on passive encounter. Also, because large pieces of artificial cover can be used, the method can sample species such as snakes which may be too large to be captured in pitfall traps. On the other hand, animals under artificial cover are not restrained in any way and must be captured by hand when the cover is lifted, so fast species may escape. This is particularly a problem later in the day when animals are warm.

We set out artificial cover made of various sizes of plywood or shelving board (Fellers and Drost 1994) set out in linear transects, alternating with pitfall traps (described above). Cover board sizes were 30 cm x 60 cm x 1.25 cm (1/2 inch plywood), 60 cm x 120 cm x 1.25 cm (1/2 inch plywood), and 30 cm x 60 cm x 3.8 cm (2 x 12 inch shelving board). In general, the cover boards were set out in systematic, repeating order with the pitfall traps (e.g. one pitfall trap, one 30 x 60 plywood board, one 60 x 120 board, one 30 x 60 shelving board, one pitfall trap, etc.; Fig. 2). Coverboards were checked by quickly lifting them to expose any reptiles or amphibians hiding underneath. As much as possible, we checked coverboards in the early morning, so the animals would be relatively cold, slow, and easy to

catch. Coverboards were only checked once per month, to minimize disturbance and allow animals to find them and become accustomed to using them for cover.

### Time-Constrained Searches

In time-constrained searches, a visual search is made through a defined area for a predetermined length of time (Crump and Scott 1994, Corn and Bury 1990). As conducted at Montezuma Castle, the technique includes turning cover and other activities to flush amphibians and reptiles that are in hiding. Number of individuals of each species found are tabulated for the time interval of the count. These searches are relative measures of abundance, and they are intended for surface-active, relatively conspicuous species. An important assumption of the technique is that the number of individuals seen is an accurate and consistent measure of the total number of individuals in the area. For this reason, time-constrained searches are less reliable for species that are highly-secretive or are highly variable in their occurrence.

Standardizing counts by amount of time spent searching allows comparison of results from one sampling interval to another and, to some extent, from one area to another (particularly when the counts are for similar species in similar habitats). An important problem with time-constrained searches is variability between observers. Even with training, different observers are likely to record different numbers of animals, due to differences in search technique or observational ability. We avoided these problems during the inventory phase of this project by having one person (EMN) conduct all of the time-constrained searches.

Each search consisted of walking a systematic path through a predefined habitat patch for a time period of one hour, looking for animals on the ground surface or in shrubs or other plants, examining and shaking vegetation clumps, looking into burrow entrances and rock crevices, turning over rocks, logs, and other debris, and sifting through leaf litter and loose soil. Areas of water were searched by either scanning them from shore or by wading through them. The Castle Unit was divided up into eight areas and the Well unit was divided into four areas for search purposes, as delineated below.

Time-constrained Search Areas:

**Castle unit**

1) Hilltop N of Castle ruins, from clifftop above Castle ruins N to Park entrance road. Crucifixion-thorn - Juniper - Creosotebush habitat.

2) Small gully E of Castle / Visitor Center, and adjacent hillslopes; bounded on 2 sides by Park entrance road. Desert Grassland / Crucifixion-thorn habitat, with rocky gully.

3) Mesquite on river flat E of Park entrance road; area of Mesquite board / pitfall transect. Mesquite habitat.

4) Beaver Creek from Park boundary on northeast, to large fork in the stream S of the sewage ponds. Habitat sycamore riparian.

5) Beaver Creek from large fork in stream to southwest Park boundary. Sycamore - Mesquite riparian.

6) W Park boundary, down to terraced slope above Beaver Creek. Creosotebush - Yucca - rocky gully.

7) S boundary and SE corner of Park. Creosotebush habitat, with some Mesquite, Crucifixion-thorn, and rocky gully.

8) Hillslope and large rocky canyon on E boundary of Park. Rocky hillside and rocky canyon.

**Well unit**

9) NE corner of Well section, N of Well and W to road. Mesquite - Creosotebush - exotic annual vegetation.

10) Area of Well, surrounding cliffs and hillslopes, and nearby rock outcrops. Rocky cliff habitat / Creosotebush / Mesquite.

11) Picnic Area / old pasture. Non-native annual grass, fencerows.

12) Beaver Creek from Picnic Area to Well. Sycamore riparian / boulder floodplain of creek.

In practice, most of the one-hour searches covered smaller areas than the original large subdivisions. Areas searched were typically discrete areas of a particular habitat, or areas characterized by habitat features thought to be important to amphibians and reptiles (e.g. rocky cliffs and outcroppings around Montezuma Well, the area of Beaver Creek along Davis Hole, and the Canotia association on the hilltops above Montezuma Castle).

### Night Surveys

Night surveys targeted nocturnal reptiles and amphibians. We conducted night surveys throughout the year in 1993. Because no animals were seen during the cold fall and winter months in this first year, we limited night surveys to the warmer months (May through October) in 1994. Monsoon periods from late July to mid-September were sampled most heavily. We conducted most night surveys from a vehicle (usually a sedan or station wagon) on established dirt and paved roads in and around Montezuma Castle and Montezuma Well, beginning immediately before dusk or 1 to 2 hours after dusk. Starting and ending times, starting and ending mileages, and weather conditions (air temperature, cloud cover, and precipitation) were recorded for each survey. Vehicle speed during the surveys ranged from 16-40 km/hr (10-25 mph). When an animal was seen on the road, we generally captured and identified it, examined it briefly, and released it. Mileage and time of each sighting / capture were recorded.

The areas driven for night surveys included 1) the Montezuma Castle entrance road, from the Visitor Center Parking Lot past the boundary gate, out to the junction with the Montezuma Castle Highway; 2) the Montezuma Castle Highway from the junction with the Montezuma Castle entrance road south to Camp Verde (just past the Verde River bridge); 3) the Montezuma Well entrance road, from the entrance gate to the parking area at Montezuma Well; 4) Beaver Creek Road from the McGuireville bridge over Dry Beaver Creek, to the Montezuma Well unit entrance; 5) Forest Road 119 from the Montezuma Well unit entrance to the junction with Forest Road 618; and 6) Forest Road 618 from the I-17 on-ramp to Beaver Creek at the Forest Service Ranger Station / campground.

We also conducted a number of night surveys on foot, with a hand-held flashlight. Most of these were along the interpretive walkways at the Castle or the Well, with the remainder along roads within the Park boundaries. The observer(s) walked through the area, scanning the walkway and adjacent area for any reptiles and amphibians. Time, weather, species, and number were recorded as for the driving surveys.

### Funnel Traps

Funnel traps consist of a cage / holding area into which one or more funnels lead. The large end of the funnel faces outward, directing animals through the narrow end of the funnel into the trap. Because of the small size of the inside end of the funnel, the animal has difficulty finding its way back out. The funnel traps we used in this survey consisted of triangular cages made of hardware cloth, with a triangular, wire screen funnel leading into the cage from either end (Fig. 4). Dimensions of the cage portion of the traps were 40 cm long x 20 cm wide. A hinged, hardware cloth door on the side of the cage allows access to remove captured animals.

Five to 10 funnel traps were set out at a time. Funnel traps were placed along the drift fences in the pitfall arrays when the pitfalls were open. Funnel traps were also placed along cliff faces, rock outcrops, and in washes to trap large lizards and snakes. In sunny areas, shades were placed over the traps to keep captured animals from becoming overheated. Like pitfall traps, funnel traps were checked daily whenever they were open.

### Handling of captures, and data collection

Erika Nowak conducted most of the sampling, assisted on occasion by volunteers, Montezuma Castle staff, or trained biologists. All animals captured in pitfall traps, funnel traps, or under coverboards were identified to species, sexed, aged (to adult, subadult, immature, or neonate) and measured. Measurements included body length (snout-vent length, measured from the tip of the snout to the vent*), tail length, and weight. Many of the animals seen during time-constrained searches, night

* the vent is the common excretory and reproductive opening in amphibian and reptiles

drives, and general surveys were not captured. These individuals were identified to species, and their sex and approximate size recorded when this could be done visually. We took photographs of representative specimens of all species captured. We did not actively collect for museum specimens, however we did salvage a number of road-killed specimens and incidental trap deaths for preservation and deposition in museum collections.

## RESULTS

### Sampling Effort

For most methods, sampling effort is reported as number of trap-nights, where 1 trap-night equals one trap open for one 24-hour period. Hence, a transect of 50 traps open for five days and nights represents 250 trap-nights. For convenience, checks of cover boards are also reported as "trap-nights." For the cover boards, one trap-night equals one check of a single board. Since the boards do not physically restrain animals using them, "trap-night" in this sense does not actually refer to a 24-hour period. Other methods, including night surveys and time-constrained searches, are reported as number of hours searched.

#### Pitfall Transects

In 1993, sampling of pitfall and coverboard transects totalled 2,725 trap-nights; in 1994, the transects were sampled on 4,289 trap nights, for a total of 7,014 trap-nights over the course of the study. Broken down by board type and trap for the two years, trapping effort was as follows:

| | trap-nights | | |
|---|---|---|---|
| Trap | 1993 | 1994 | Total |
| 1'x2'x1" | 335 | 367 | 702 |
| 1'x2'x2" | 383 | 388 | 771 |
| 2'x4'x1" | 240 | 230 | 470 |
| pitfalls | 1,767 | 3,304 | 5,071 |

### Pitfall Arrays

In 1993, pitfall arrays were sampled for 108 trap-nights, and in 1994, for 1,326 trap-nights, or a total of 1,434 trap nights.

### Time-Constrained Searches

We conducted a total of 71 1-hour time-constrained searches (42 at Montezuma Castle and 29 at Montezuma Well), distributed throughout every month in the active season. Habitat coverage for time-constrained searches was as follows:

Riparian: 14 hours;

Cliff/Outcrop: 10 hours;

Larrea-dominated associations: 11 hours;

Canotia-dominated associations: 11 hours;

mature mesquite bosque: 4 hours;

immature mesquite/acacia: 8 hours;

grassy meadow: 2 hours;

grassland/juniper association: 9 hours; and

grassland/acacia association: 2 hours.

### Night Surveys

We conducted a total of 87 night-driving searches over the course of the inventory. As noted, surveys were conducted throughout the year in 1993. Because virtually no reptiles or amphibians were found during the cold months (November through March), we only conducted night surveys from May through October in 1994, and most of the surveys that year were during the monsoon period, from late July through mid-September. A total of 72.7 hours were spent in night drive searches, 35.5 hours around Montezuma Castle and 37.2 hours around Montezuma Well. This amounted to 1,336 road km (830 miles), 357 km (222 mi.) around Montezuma Castle and 979 km (608 mi.) around Montezuma Well.

### Funnel Traps

We set funnel traps out for a total of 163 trap-nights: 75 at Montezuma Castle and 88 at Montezuma Well.

### Incidental Observations

We captured and identified five snake species that were not recorded by any of our standard sampling techniques, including glossy snake, ring-necked snake, Sonoran whipsnake, black-necked garter snake, and western coral snake. These snakes were found in the settling ponds at Montezuma Castle, on the trails around the Castle visitor center or on roads (during times when we were not conducting formal surveys), or during other fieldwork. Montezuma Castle staff made a number of the sightings and captures (including the one coral snake recorded during the survey).

### Number of Species

A total of four amphibian species and 32 reptile species were recorded from Montezuma Castle and Montezuma Well during the study (Appendix 1). The four amphibians included two toads, one treefrog, and one true frog (the introduced bullfrog). The reptile species included two turtles, 15 lizards, and 15 snakes. In addition, one lizard species and one snake species were recorded within 0.8 km of Montezuma Well's boundary and these species are thus presumed to be present at least occasionally on the monument. Possible hybridization between Woodhouse's Toad (Bufo woodhousei) and Southwestern Toad (B. microscaphus) (Sullivan and Lockwood 1991) and the whiptails (Cnemidophorus sp.) confounds determination of some individuals of these groups. We did not find any toads that were clearly B. microscaphus, though a few individuals appeared to have intermediate characters between the two taxa. Positive determination of possible hybridization awaits further examination of these specimens.

Similarly, some of the whiptails caught appeared to be intermediate in certain diagnostic characteristics. Detailed analysis of these unusual individuals has not been completed yet; the species listed are those that were clearly identifiable.

### Relative Abundance

The most abundant taxa by far are the lizards, with the Western Whiptail and the Side-blotched Lizard the most commonly observed and trapped. There were 173 captures (at least 136 individuals) and 26 sightings (during time-constrained searches) of Western Whiptail and 131 captures (at least 94 individuals) and 37 sightings of Side-blotched Lizard.

Woodhouse's Toads are also very abundant: there were 33 captures and 507 sightings during time-constrained searches. The larval (tadpole) and toadlet stages were much more commonly observed in 1993 than in 1994. The most commonly observed snakes were the whipsnakes, Masticophis sp. (three sightings during time-constrained searches), and Patch-nosed Snake (one sighting and two captures).

Abundance data for each species captured is given on a per 100 trap night basis for all trapping methods combined and per one hour of time-constrained searching in the following table.

**Amphibians**

| | Pitfall Array (per 100 nights) | Night Survey (per 100 hours) |
|---|---|---|
| Woodhouse Toad | 1.67 | 42.6 |
| Red-spotted Toad | 0.07 | 8.25 |
| Canyon Treefrog | 0.0 | 1.37 |
| Bullfrog | 0.0 | 1.37 |

**Lizards**

| | Pitfall | TCS |
|---|---|---|
| Side-blotched Lizard | 2.01 | 52.1 |
| Western Whiptail | 1.68 | 36.6 |
| Arizona Alligator Lizard | 0.99 | 2.8 |
| Desert Grassland Whiptail | 0.49 | 5.6 |
| Desert Spiny Lizard | 0.34 | 4.2 |
| Tree Lizard | 0.02 | 26.8 |
| Greater Earless Lizard | 0.02 | 39.4 |
| Clark Spiny Lizard | 0.02 | 15.5 |

Woodhouse's Toad choruses and larvae numbers were more abundant at Montezuma Castle, as were Bullfrogs, Western Whiptails, Banded Geckos, and Western Diamondback Rattlesnakes. In contrast, Red-spotted Toads, Gila Spotted Whiptails, Desert Grassland Whiptails and both turtle species were more abundant at Montezuma Well. Other species were not conspicuously more abundant at one unit of the Monument vs. the other.

## Sampling Effectiveness

### Pitfall Traps, Artificial Cover, and Arrays

The overall capture rate for pitfall and coverboard transects was 6.74 individuals per 100 trap nights, with a total of 19 species captured. The following table compares relative capture rates of the one-gallon pitfalls and the three different sizes of coverboards within each transect. Capture rates are expressed per 100 trap nights. "Additional species" are species caught by one of the four methods that were not caught by any of the others:

| Trap type | Capture rate | Total species | Additional species |
|---|---|---|---|
| One-gallon pitfall | 4.16 | 12 | Western Banded Gecko, Western Patch-nosed Snake |
| 1'x2'x1" coverboard | 2.14 | 6 | Red-spotted Toad |
| 1'x2'x2" coverboard | 3.10 | 9 | Black-tailed Rattlesnake |
| 2'x4'x1" coverboard | 9.36 | 9 | Clark Spiny Lizard |

Collared lizards were found more frequently under boards than in pitfall traps. We caught eight collared lizards under coverboards (all three types combined), but only one in a pitfall trap.

Success rates for all trap types were slightly higher for 1994, suggesting that acclimatization time for the coverboards may be important.

Five-gallon pitfall arrays were the most effective trapping method, with a success rate of 16.60 individuals (17 species) per 100 trap nights. Again, the success rate was higher for 1994 than for 1993, but the increase in number of arrays in 1994 may account for part of this increase in trapping success.

### Funnel Traps

For hardware cloth funnel traps, the success rate was 2.45 individuals (4 species) captured per 100 trap nights.

### Time-Constrained Searches

For time-constrained searches, the success rate was 15.80 individuals observed per hour of searching. It is important to note that 42% of these individuals could not be captured and so were not identified to species. Almost all individuals were observed on sunny days between the months of April and August, and almost no individuals were seen on cloudy days or in the cooler months.

### Night Surveys

For night drives, the success rate was 2.1 individuals (14 species) observed per hour of driving (0.19 individuals per mile). At Montezuma Castle, the success rate was 1.3 individuals (7 species) observed per hour (11.27 individuals per 100 miles), and at Montezuma Well, the success rate was 3.0 individuals (11 species) observed per hour (7.24 individuals per 100 miles). Six new species of snakes and 1 new lizard were found on or near the Monument using this sampling technique. As previously mentioned, two of these species were not seen on either unit of the Monument, but were found on roads within 0.5 miles of Montezuma Well. Most individuals were seen on night drives during the hot monsoon period between July and early September.

### Habitat Associations

Strong habitat associations were seen for some species. Anurans and turtles were rarely seen or trapped away from permanent water sources. All of the Spiny Lizards (*Sceloporus* spp.) were found in habitats with trees or large shrubs: in mesquite, juniper, and Canotia vegetation associations and riparian areas. Clark Spiny Lizards and Eastern Fence Lizards were restricted primarily to moist habitats with mature tree canopy, as were Tree Lizards, Arizona Alligator Lizards, and Ring-necked Snakes. A trend toward moist habitat association was also seen for Night Snakes and Black-tailed Rattlesnakes. Collared Lizards were found only near substantial rock outcrops, and Sceloporus spp. and Tree Lizards used this vertical structure as well.

Most Whiptails (Cnemidophorus spp.) were found primarily in grassland vegetative associations, with the exception of the Western Whiptail, which is a habitat generalist. Two species, Gila Spotted and Desert Grassland Whiptails, were more common in an irrigated grassy meadow at Montezuma Well than in any other habitat. This meadow is scheduled for restoration to mesquite bosque, but the presence of these whiptails and other species suggests that converting the meadow to a drier habitat is not the best way to preserve biological diversity at the Monument. Only one species, the Western Diamondback Rattlesnake, was clearly associated primarily with drier upland habitats.

In addition to Western Whiptails and Side-blotched Lizards, the whipsnakes (Masticophis sp.), and Patch-nosed Snake were widely distributed, and appear to be rather general in the habitats they utilize at the Monument. Sample sizes for other species such as Western Banded Gecko, Ground Snake, Long-nosed Snake, and Common King Snake were not large enough to permit analysis of habitat associations.

## DISCUSSION

### Completeness of survey

The variety of sampling techniques used worked well to provide a thorough inventory of the Montezuma Castle area. Only a few "new" species were captured in the second year of sampling (i.e. species that were not encountered during the first year), and none were found in the third year. A few secretive species that can be difficult to sample deserve specific mention. Fossorial species of reptiles, such as some snakes, can be very difficult to find. However, we made a special effort to look for these species. We caught Ground Snakes under artificial cover boards and in pitfall traps, and encountered Ringneck Snakes during night surveys. On the other hand, we only encountered two Coral Snakes (both in the sewage ponds at the Castle unit), and did not find some other species that may occur in the area, such as the Western Blind Snake. It is possible that some additional secretive species are present at the Monument, that we did not find.

No skinks were encountered in the course of our inventory. We included both the Many-lined skink (Eumeces multivirgatus) and Great Plains skink (E. obsoletus) on the "hypothetical" species list that we prepared at the beginning of the inventory, as both species are known from the central Arizona area. The many-lined skink, in particular, is known to occur in streamside thickets in desert areas of central Arizona. The sampling techniques that we used, especially cover boards and pitfall traps, should have taken these species if they were present.

### Problems encountered

We experienced some minor problems during the course of the survey due to trespass cattle trampling cover boards and pitfall traps. This was primarily a problem during the first year, in the trap set in the grassy picnic area at the Montezuma Well unit. We also noted a few instances where unknown persons disturbed pitfall traps or cover boards. Both of these were relatively rare occurrences, given the extent and duration of sampling, and we do not feel they negatively affected our results.

Although we conducted road driving throughout the course of the inventory study, and it provided valuable information on secretive snakes at the Monument, there are important drawbacks to this sampling technique at Montezuma Castle. Road areas within Monument boundaries are quite limited, so much of our survey area was on roads in the immediate vicinity of the Castle and the Well. Traffic on these roads, particularly the Montezuma Castle Highway and the McGuireville Road, was heavy at times. Driving slowly and stopping frequently under such conditions is potentially dangerous, and we do not recommend this method for future surveys at Montezuma Castle.

Identification of some of the striped whiptail lizards (*Cnemidophorus* spp.) was problematic. Scale characters generally used to identify these species were quite variable in some of the specimens we examined. At this time, we do not know if there is one, or two, or perhaps even three species of striped whiptails in the Monument area. We will attempt to have unusual specimens examined by experts with this group, to verify what species occur at Montezuma Castle.

A survey method that was not used during this survey, but should be used in future reptile and amphibian surveys in dry climates, would be a daily or every other day survey of the sewage lagoons during the warm months. As mentioned below, several snake species became trapped in the lagoons during these months, presumably after they went into the lagoons to drink or to forage. This is also a potential management problem, and Parks may want to surround their lagoons with snake proof fencing to decrease snake mortality in the warm months.

### Species distribution

Most species captured were well within the known limits of their natural range as shown in Stebbins (1985). One exception is the Slider, *Pseudemys scripta*, which is introduced into the Well. Two individual Western Coral Snakes, *Micruroides euryxanthus*, were found trapped in the sewage ponds at Montezuma Castle, and this is near the northern edge of their range in Arizona. Other species recorded in our survey that are at or near the northern extent of their range include the Sonoran Mud Turtle, which is fairly common in Beaver Creek and abundant in Montezuma Well; the Western Banded Gecko; the Greater Earless Lizard; the Clark Spiny Lizard (near the northern edge of its range); and the Mojave Rattlesnake (near the northeastern margin of range at Montezuma Castle).

Species which range into the general area of Montezuma Castle and Montezuma Well, but which were not recorded during this study include: spadefoot toads (*Scaphiopus spp.*), leopard frogs (*Rana spp.*), Lesser Earless Lizard. Leopard Lizard, skinks (*Eumeces sp.*), Western Blind Snake, Southwestern Black-headed Snake, and the Western Rattlesnake (the subspecies called the Arizona Black Rattlesnake, *Crotalus viridis cerberus*). Of these, the Western Rattlesnake has recently been recorded within 10 miles of Montezuma Castle.

As noted earlier, there are historical records for *Heloderma suspectum* at Montezuma Castle. Although none were seen in the area during our study, we received a recent report of one about 5 miles north of Montezuma Well along Wet Beaver Creek just north of the Beaver Creek Campground, and one was seen in the Village of Oak Creek, about 30 miles northwest of Montezuma Well, in the summer of 1994. The single sighting of a dead Short-horned Lizard near Montezuma Well was surprising, given the apparent abundance of suitable habitat and ant colonies at both units.

## MANAGEMENT RECOMMENDATIONS

Some changes are known to have occurred in the amphibian and reptiles fauna at Montezuma Castle National Monument. Leopard Frogs have disappeared from stream habitats in the vicinity of the Monument, as they have across much of Arizona. Our surveys did not find Southwestern Toads, though they are known from similar habitats in nearby areas. Also, we did not find Gila Monsters, which were formerly recorded at the Monument. Loss or decline of some species may be related to decline of healthy desert grassland, and other species (such as the Leopard Frogs) may have declined due to adverse changes in aquatic habitats. The aquatic habitats at the Monument, including the associated riparian community, appear to be the habitats that face the greatest threats currently. With that in mind, we make the following management recommendations:

* High priority should be given to protecting stream flow, water quality, the natural hydrologic regime, and native aquatic species (e.g. by protecting and restoring native fish species). Maintaining a healthy riparian community and aquatic habitats is important for the herpetofauna, particularly the amphibians.

* Continue to monitor amphibian populations. Amphibian populations in much of the western United States have experienced serious declines. The cause of many of the declines is not known, and part of the reason for this is that we do not have good baseline information on amphibian populations. Given the extensive inventory work at Montezuma Castle, this area would be a valuable site for continuing to collect information on population trends.

* Encourage restoration of native grassland habitats. Some of the declines that have occurred at Montezuma Castle (including, possibly, the Gila Monster) seem to be related to decline and loss of desert grassland habitat. Unfortunately, we do not have detailed information on past habitat composition and structure at the Monument, but restoration of native species in general (and reduction of non-natives such as Red Brome) should be beneficial.

* Reintroduce Lowland Leopard Frog, if the opportunity arises. The Arizona Game and Fish Department is carrying out intensive studies and restoration efforts for leopard frogs in the state.. The species formerly occurred at Montezuma Castle, and suitable habitat remains. Montezuma Castle would be a good candidate for a reintroduction effort for this species.

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**Appendix 1.** Natural history notes on amphibians and reptiles of Montezuma Castle National Monument, based on observations during the Montezuma Castle survey, 1992 - 1995 [compiled by Erika M. Nowak]. Each species is discussed according to the following outline:

"IDENTIFICATION": "GENERAL" applies to general descriptions of the species: of both sexes and all age classes. Special characteristics of adult males, adult females, or young are given under respective headings. Size is given in cm, and is the snout-vent length in amphibians and lizards, the shell length in turtles, and the total length in snakes and larval amphibians. A glossary of descriptive terms used in species identification follows in Appendix 1.

"MOCA HABITAT" is the probable location of the species in different habitats or soil types at Montezuma Castle (MOCA) and Montezuma Well (MOWE) units.

"ACTIVITY PERIOD" is the time of day or part of the season that the species is likely to be active and encountered.

"REPRODUCTION" is the time and location of breeding, the number of young produced, and the month when the young first appear.

"STATUS" gives the federal and state listing status based on the Arizona Game and Fish Department's 1988 listing. "Endangered" species are those either extinct in Arizona since the mid-1800's or for which extinction is very probable without prompt conservation efforts. "Threatened" species are those that could go extinct in Arizona in the near future, due to serious threats, decreased population numbers, and/or extremely small and local populations. "Candidate Threatened" species have known or suspected threats, but do not have substantial population declines documented from historical levels.

"SPECIMENS" lists the number, date, and current location of any specimens collected at or near MOCA.

Taxonomy and Latin names follow Stebbins, 1985. References are given at the end of the species listings for each reptile and amphibian family. Field identification tips discovered during the course of the survey are underlined.

Order Anura (Frogs and Toads)

Family Bufonidae

Southwestern (Arizona) Toad (*Bufo microscaphus microscaphus*)

RANGE: MOCA may be included within the range, which consists of scattered populations along Colorado River tributaries. Has not been confirmed on the monument as of September 1, 1995.

MOCA HABITAT: Primarily in loose, gravelly areas of streams and arroyos with intermittent streams or on sandy banks of quiet waters.

ACTIVITY PERIOD: Nocturnal except during the breeding season.

IDENTIFICATION:GENERAL: 5-8 cm. Voice a musical trill, often rising in pitch and ending abruptly. Olive to brown-pink above with little spotting. Light area across eyelids and front half of widely separated, oval parotoid glands. Cranial crests weak or absent. Light area on each sacral hump and on back (Stebbins 1985, p 73).

MALE: Throat not dark.

FEMALE:

YOUNG: Tadpoles olive, tan, to gray above, mottled with brown or black. White below. Tail musculature with dark marks (Stebbins 1985, p 266). Eyes on top of head close to edge. Tadpoles transform at about 4 cm. Young white, light olive, or salmon above, and may have black spots. Red-tipped tubercles on back. Underside of feet yellow.

REPRODUCTION: Breeds March to July, independent of rains. Lays up to 4000 eggs in 1-3 rows as strings on bottom of pools in quiet streams. Hybridizes with B. woodhousei in the Cave Creek and Verde River drainages (Stebbins 1951, p. 266).

STATUS: Not listed.

SPECIMENS:

Woodhouse's Toad (*Bufo woodhousei woodhousei*)

RANGE: MOCA is included in the western part of the range.

MOCA HABITAT: Primarily in sandy areas of desert lowlands, canyons, or floodplains. Near irrigation ditches and in burrows (Stebbins 1951, p 288). Found in all habitats at MOCA and MOWE, especially near irrigated areas.

ACTIVITY PERIOD: Primarily nocturnal, but occasionally diurnal.

IDENTIFICATION:GENERAL: 4-13 cm. Voice is a "w-a-a-a-h" resembling a sheep bleat, or a calf bawl (Stebbins 1985, p 72). White dorsal stripe, prominent cranial crests, elongate divergent parotoids. Gray, yellow-brown, olive, or black above with dark blotches. Yellow and black network on rear of thighs. Cranial crests contact elongate parotoids (Behler and King 1979, p 398).

MALE: Pale yellow border of lower jaw, sooty gray throat, and round vocal sac.

FEMALE: Throat cream.

YOUNG: Tadpoles gray to slate above with light mottling. Lower part of tail musculature lacks dark pigment. Eyes on top of head close to edge. Transform at about 2-3 cm., and are very dark (Miller et. al. 1982, p 45).

REPRODUCTION: Breeds April to July (a few call into September) in quiet water of river floodplains, streams, marshes, temporary pools, or irrigation ditches. Lays up to 25,000 eggs in 1-2 rows as strings intertwined around vegetation or debris.

STATUS: Not listed.

SPECIMENS: 2 toadlets from MOCA not yet catalogued.

Red-Spotted Toad (*Bufo punctatus*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Primarily among rocks near desert streams and oases, scrubland, rocky canyons, and river floodplains. Near springs and seepages (Stebbins 1951, p 281). Found at MOWE in mesquite bosque and near riparian habitats.

ACTIVITY PERIOD: Nocturnal, but may be diurnal when breeding. Behler and King (1979, p 395) say it is crepuscular. Most active during the monsoon season.

IDENTIFICATION:GENERAL: 4-8 cm. Voice a high bird- or insect-like trill. Flattened head and body. Round parotoids about the same size as the eyes. Snout very pointed.

Cranial crests weak or absent. Light gray, olive, or red-brown above with red or orange warts.

MALE: Throat dusky.

FEMALE:

YOUNG: Tadpoles black or dark brown above. Coarse spotting on dorsal fin (Stebbins 1985, p 266). Eyes on top of head close to edge. transforms at about 3.5 cm. Young with numerous red and orange-tipped warts. Dark spotted below. Underside of feet yellow.

REPRODUCTION: Breeds March to September during or after rain in springs, temporary pools of intermittent streams, or reservoirs. Lays eggs singly in short strings or in a loose, flat cluster on the bottom of shallow, often rocky pools. Many newly metamorphosed young were seen in August at Pena Blanca Springs, AZ (Stebbins 1951, pp 280-285).

STATUS: Not listed.

SPECIMENS:

Family Hylidae

Canyon Treefrog (*Hyla arenicolor*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Arid areas close to rocky washes, canyons, streams, and permanent pools, usually on the ground. Often found in intermittent or permanent streams with quiet pools and hard, rocky bottoms (Stebbins 1985, p 79).

ACTIVITY PERIOD: Primarily nocturnal. Found hiding among rocks or in damp rock crevices close to water courses during the day.

IDENTIFICATION:GENERAL: 3-6 cm. Voice is an explosive, single-pitched whirring. Fat and warty, toad-like. Olive to brown-gray with dark blotches. Dark-edged light spot beneath the eye. Yellow-orange under thigh. Large toepads. No eyestripes. Distinctive fold between the forelegs on the chest area (Miller et. al. 1982, p 47).

MALE: Gray-blue throat.

FEMALE:

YOUNG: Tadpole with eyes just within the outline of the top of the head (Stebbins 1985, p 268). Golden brown above without dark bars on tail musculature. Transforms at about 3 cm.

REPRODUCTION: Breeds March to July with adequate rain, in quiet water and pools of rocky streams and canyons (Smith 1951, p p 314-321). Seen calling among rocks on the edge of Davis Hole in Wet Beaver Creek at MOCA in May.

STATUS: Not listed.

SPECIMENS:

Family Ranidae

Northern Leopard Frog (*Rana pipiens*)

RANGE: MOCA may be included on the southwest edge of the range. Has not been confirmed on the monument as of September 1 1993.

MOCA HABITAT: Found in a variety of habitats near the permanent water and aquatic vegetation growth of springs, streams, irrigation ditches, and reservoirs: grassland, scrubland, and woodland. Forages far from water in moist grassy and wooded habitats.

ACTIVITY PERIOD: Diurnal and nocturnal.

IDENTIFICATION:GENERAL: 5-11 cm. Voice is a low guttural snore. Brown back with well-defined, pale-bordered oval or round dark spots. White stripe on upper jaw. Dorsolateral folds well-defined, continuous, and not angled inward.

MALE: Loose skin between jaw and shoulder (Stebbins 1985, p 88). Swollen, darkened thumb base.

FEMALE:

YOUNG: Tadpoles dark brown, olive, to gray above with fine gold spots. Cream to white below, with intestines often showing through weak pigment (Stebbins 1985, p 270). Eyes in middle of each outer side of head Transform by about 8.5 cm. Young have spotting reduced or absent.

REPRODUCTION: Breeds mid-March to early June. Smith (1951, p 361) notes that it breeds February to December, with peak breeding April to August. Lays up to 6500 eggs in firm, globular clusters (containing 2-3 envelopes) attached to vegetation in quiet permanent water (Stebbins 1985, p 258). Probably hybridizes with R. chiricahuensis in this area.

STATUS: STATE: Candidate threatened.

SPECIMENS:

Chiricahua Leopard Frog (*Rana chiricahuensis*)

RANGE: MOCA may be included on the northwestern edge of the range. Has not been confirmed on the monument as of September 1 1993.

MOCA HABITAT: Primarily in rocky streams or deep, rocky pools, river overflow pools, springs, and stock tanks in oak woodland and scrubland, from 3500-7000 feet.

ACTIVITY PERIOD: Diurnal and nocturnal.

IDENTIFICATION:GENERAL: 5-14 cm. Voice a single long, snore-like note dropping in pitch at the end. Rounder head, rougher skin, and shorter legs than R. pipiens. Dorsolateral folds broken into short segments and angled inward at their posterior ends. Gray to brown above. Upper white lip stripe diffuse in front of eye. Gray face. Rear of thigh speckled with salt and pepper marks: small light spots, each with a tubercle, scattered over dark ground color. Some yellow on groin, lower abdomen, and base of thighs. Thighs dark with scattered light spots.

MALE: Swollen and darkened thumb base. Prominent vocal sacs.

FEMALE:

YOUNG:

REPRODUCTION: Breeds late March to June and sporadically in fall.

STATUS:STATE: Threatened.

SPECIMENS:

Lowland Leopard Frog (*Rana yavapaiensis*)

RANGE: MOCA may be included on northern edge of the range. Stebbins (1985, p 91-92) notes that this species in found in the Colorado River drainage from the Virgin River, and in central Arizona below 4800 feet. Has not been confirmed on the monument as of September 1 1993.

MOCA HABITAT: Found near permanent pools of foothill streams, overflow ponds and side channels of rivers, permanent streams, and dirt stock tanks in desert grassland, and oak woodland.

ACTIVITY PERIOD: Diurnal and nocturnal.

IDENTIFICATION:GENERAL: Similar to *R. chiricahuensis*, but biochemically a distinct species (Stebbins 1985, p 91-92). Dark network on rear of thighs. Yellow groin color extends onto rear of belly and underside of legs. Tan, gray-brown, or light gray-green above.

MALE:

FEMALE:

YOUNG:

REPRODUCTION: Breeds February to April; sometimes fall. Stebbins (1985, p 91) notes that south of the Mogollon rim this species may hybridize with *R. chiricahuensis*.

STATUS:STATE: Candidate threatened.

SPECIMENS:

Bullfrog (*Rana catesbiana*)

RANGE: MOCA is included on the northern edge of the Arizona range.

MOCA HABITAT: Primarily near or in relatively deep permanent water with thick aquatic vegetative growth and mud bottoms. May leave water during wet weather (Smith 1951, p 348). In Wet Beaver Creek at MOCA, possibly MOWE.

ACTIVITY PERIOD: Diurnally and nocturnal. during the day they are most likely to be found near the water's edge, but at night may be seen further out in the water.

IDENTIFICATION:GENERAL: 8-20 cm. Voice is a deep "jug-o-rum." Olive-green to brown above. Light green on head or upper jaw. Legs banded dusky. Mottled with gray on venter. Yellow tinge on chin and hindquarters. No dorsolateral folds.

MALE: Yellow throat. Eardrum size larger than eye size.

FEMALE: Eardrum size about equal to eye size.

YOUNG: Tadpoles olive green above and white to pale yellow below (Stebbins 1985, p 272). Eyes near each outer edge of top of head. Transform at about 10-17 cm. (Behler and King 1979, p 372). Young are very mottled on all over, with a mostly unmarked light green head.

REPRODUCTION: Breeds February to July. Lays up to 20,000 eggs in a large floating cluster (0.3-1.5 m across) that may be attached to vegetation or free near the edge of permanent, quiet water (Stebbins 1985, p 257). No evidence of successful reproduction as of September 1 1993.

STATUS: Not listed.

SPECIMENS:

Order Testudines

Family Kinosternidae

Sonoran Mud Turtle (*Kinosternon sonoriense*)

RANGE: MOCA is included on the northern edge of the range.

MOCA HABITAT: Primarily creeks and streams. Also springs, waterholes, and ponds. In Wet Beaver Creek and the Well.

ACTIVITY PERIOD: Primarily diurnal.

IDENTIFICATION:GENERAL: 8-17 cm. Small, relatively highly domed, elongated carapace with 1-3 low keels. Tenth marginal scute extends higher than the other scutes. Underside of marginal scutes and bridge yellow-brown. Long tubercles on throat. Head mottled with light and dark marks.

MALE: 2 patches of horny scales on inner surface of each thigh. Tail with horny, hooked tip.

FEMALE:

YOUNG:

REPRODUCTION: Lays 2-9 eggs May to September. Young begin hatching in August from upland areas near Wet Beaver Creek and the well at MOWE.

STATUS: Not listed.

SPECIMENS: 1 carapace and plastron from MOWE not yet catalogued.

Family Emydidae

Common Slider (*Trachemys scripta*)

RANGE: MOCA is not included within the natural range; this species has been introduced here. Closest natural range is New Mexico.

MOCA HABITAT: Primarily in quiet water with abundant aquatic vegetation, including shallow streams, ponds, and slow rivers with soft bottoms. Very aquatic. In Wet Beaver Creek and the well at MOWE.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 9-36 cm. Oval carapace with lengthwise wrinkles and streaks of yellow on olive or dusky background. Yellow markings may be obscured with black. Head and legs yellow striped. Broad red or orange spot or stripe behind eye. Underside of carapace and plastron edges with symmetrical dusky blotches. Lower jaw looks rounded from the front. Vertical streaking on second and third costal shields. Rear of carapace has saw-tooted margin.

MALE: Darker in color. Long nails on front feet.

FEMALE:

YOUNG: Carapace gray and streaked with yellow. Red or yellow stripe behind eye. Plastron has many dark spots.

REPRODUCTION: Lays 1-3 clutches of 2-25 eggs, April to July. Hatchlings may emerge in 2-2.5 months but also may overwinter in nest.

STATUS: Not listed.

SPECIMENS:

Family Trionychidae

Texas Spiny Softshell (*Trionyx spiniferus emoryi*)

RANGE: Includes MOCA: introduced into Colorado River system from New Mexico about 1900 (Stebbins 1985, p 109). Has not been confirmed on the monument as of September 1 1993.

MOCA HABITAT: Primarily in rivers with quiet water and a mud, sand, or gravel bottom. Also in permanent ponds and waterholes.

ACTIVITY PERIOD: Primarily diurnal. Active April to September.

IDENTIFICATION: GENERAL: Extremely flat, pancake-like carapace covered with leathery skin. Strongly webbed feet. White ridge in each nostril on a very pointed head. Front edge of carapace covered with tubercles.

MALE: Smaller; carapace sandpapery in texture. Tail thick and extends well beyond edge of carapace.

FEMALE: Larger; carapace smooth with well-developed tubercles at front edge. Carapace mottled with light and dark green-gray (Webb 1973, p 140.1).

JUVENILE: White carapace border conspicuous. Carapace spotted with black and dark markings on head and limbs.

BREEDING PERIOD: Lays 1-2 clutches of 4-33 eggs May to August in sandy banks. Young hatch late August to October, or the following spring.

STATUS: Not listed.

SPECIMENS:

Order Squamata (Lizards and Snakes)

Family Iguanidae

Greater (Southwestern) Earless Lizard (*Cophosaurus texanus scitulus*)

RANGE: MOCA is included within the northwestern tip of the range.

MOCA HABITAT: Primarily in open areas with sparse vegetation and sandy or gravelly soil. On low hillsides, rocky flats, washes, and intermittent stream bottoms among cactus, mesquite, crucifixion-thorn, and creosote bush.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION: GENERAL: 5-8 cm. About 13 femoral pores. May run with tail curled over head (Stebbins 1985, p 171), exposing undertail barring. Back grey-brown, occasionally with a bluish tinge. Dorsal spots increase in size posteriorly, fusing on the tail to become crossbars that continue to the tip. 2 diagonal dark brown-black bands on sides in front of groin, separated and bordered by light yellow or orange areas.

MALE: Small pink, orange, or yellow spots on back. Throat yellow to pink, and reticulated with gray. Chest may also be gray. A broad blue patch around 2 black diagonal bands on the belly that have continued from the side stripes in front of the groin.

FEMALE: Less brightly colored above. Sides unmarked, but may have faint belly bars on otherwise uniform cream venter. Throat reticulated like males, but no bright colors.

YOUNG:

REPRODUCTION: Lays 1-2 clutches of 2-12 eggs March to August; hatching begins in mid-July.

STATUS: Not listed.

SPECIMENS: 2 males from MOCA not yet catalogued.

Common (Western) Collared Lizard (*Crotaphytus collaris baileyi*)

RANGE: MOCA is included in the western part of the subspecies range.

MOCA HABITAT: Primarily rocky, open areas: canyons, limestone ledges, rocky hillsides, and small boulder-strewn alluvial fans. Most common around the rim of the well at MOWE. Also near large rocks, cliffs, and in canyons at both MOWE and MOCA.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 8-12 cm. May run bipedally. Large head with narrow neck, and large oval earhole. Venter cream with dark reticulation only near lower jaw. Double black neck collar. Back has greenish-blue to greenish-yellow highlights, and 6 narrow gray crossbands. Tail and legs also have crossbands, which may be faint.

MALE: Head broader and more muscular. Back ground color orange or yellow, intensifying posteriorly. Throat yellow or orange.

FEMALE: like male but duller and rarely has orange ground color.

YOUNG: Colors not brilliant. Broad neck collar with coarse reticulation of light marks on dark background. Body crossbands dark and may enclose large light areas.

REPRODUCTION: Lays 4-24 eggs in early August.

STATUS: Not listed.

SPECIMENS: 1 female from MOCA not yet catalogued.

Eastern Fence (Southern Plateau) Lizard (*Sceloporus undulatus tristichus*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Variety, all involving a vertical aspect; in bushes, trees, old buildings, downed wood, rocky areas, rodent burrows of grassy areas, pinyon-juniper woodlands, open shrub or woodlands, or stream courses. In mesquite, crucifixion-thorn, and juniper habitats at MOWE and MOCA.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 5-7 cm. Gray, brown-red, or blackish above with crossbars, crescents or light stripes. In this area, generally with a wide white stripe along each side. Dark band along rear of thigh. Preanal folds do not reach anteriorly to femoral pore row.

MALE: Usually 2 widely separated blue throat patches, possibly with black borders. Two dorsal patterns: distinct light dorsolateral stripes with 9-10 faint dark stripes on either side, or, light stripes faint and dark spots large, becoming undulate dark bars on back. White venter areas suffused with many small blue flecks. Black line down center of back evident at various places. Enlarged postanals.

FEMALE: Often with pale blue patches on belly, without black borders. Same throat markings as male; blue throat patches always separated. Poorly defined dorsolateral light stripes and well-defined dark undulate bars on back. No blue spot suffusion on throat and belly.

YOUNG: Like female.

REPRODUCTION: Lays 1 or more clutches of 4-19 eggs May to June; hatch in 8-11 weeks.

STATUS: Not listed.

SPECIMENS:

Desert Spiny Lizard (*Sceloporus magister*)

RANGE: MOCA is included within the range.

MOCA HABITAT: A variety of habitats with vertical aspect; catclaw thickets, rockpiles, stone ruins, along cliffs, undercut wash banks. In cottonwood-willow riparian, mesquite-yucca grassland, and creosotebush associations. Most common along cliffs and canyons at MOWE and MOCA.

ACTIVITY PERIOD: Diurnal. Hibernates.

IDENTIFICATION:GENERAL: 14 cm. Large dorsal scales. Black wedge- shaped mark on each side of neck, edged at the rear with white or yellow. Yellow to brown above with crossbands that fade with age, or brown with a black to purple mid-dorsal stripe bordered by light stripes. Head orange. No dark crossbands on forelegs. 5 scales at front of ear opening.

MALE: Sides darker than back with dim diagonal light lines crossing them. Tail may be dimly banded. A dark streak runs posteriorly from the eye to join the upper sides. Triangular black patch in front of foreleg. Groin are blue. Belly patches dark blue with light blue spots in diagonal rows; may meet and extend forward onto chest. Middle of gular region light blue, and posteriorly it meets with a narrow black area that joins the nuchal collar. Enlarged postanals and swollen tail base.

FEMALE: Venter white and unmarked. Nuchal collar not black. Dorsal crossbands more evident. Breeding female has brown head and faint blotches on back.

YOUNG: Like female. Many small blotches in 4 parallel rows on back. Conspicuous crossbands.

REPRODUCTION: Lays 1 or more clutches of 4-19 eggs May to June; hatch in 8-11 weeks, often in July.

STATUS: Not listed.

SPECIMENS: 1 male from MOCA not yet catalogued. #2243 at the Museum of Northern Arizona, collected at MOWE on 10/2/58 by D. Breternitz and W.H. Woodin.

Clark's Spiny Lizard (*Sceloporus clarki*)

RANGE: MOCA is included in the northwestern part of the range.

MOCA HABITAT: Primarily in or near trees, in more humid environments; near rockpiles and outcrops. Along wooded canyons and streams.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 7-13 cm. Dark crossbands on lower forelegs and feet. 3 scales at front of ear opening. Greenish sheen on back. Black mark on shoulder on may form incomplete nuchal collar.

MALE: Gray with black flecks and sometimes irregular, narrow, dark lines on edges of lateral scale rows. Throat pale blue, purple, or gray posteriorly. Anteriorly throat is dark blue surrounded by black. Belly patches are blue, light purple, or gray, and reach from armpits to groin.

FEMALE: Resemble juveniles. Shoulder crossband less evident. No belly patches. Throat has broad dark lines and with belly, may be mottled.

YOUNG: Gray with 6-7 narrow, undulating dark brown lines radiating from sides to center of back. Dark band crossing shoulders. Body sides dark and irregularly marked with dark brown, possibly crossband extensions. Narrow dark crossbands on legs and tail.

REPRODUCTION: Lays 1 or more clutches of 4-22 eggs May to November; hatching begins in mid-July.

STATUS: Not listed.

SPECIMENS: 1 male from MOWE not yet catalogued.

Tree Lizard (*Urosaurus ornatus*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Primarily found on rocks, trees, fence posts, buildings, trees, and bushes along river and stream courses and dry washes; arboreal. Also likely to be found

in pairs or groups on boulders (Behler and King 1979, p 536), in pinon-juniper to willow-poplar habitat along streams. Common in mesquite, juniper, and crucifixion-thorn at MOWE and MOCA.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 4-6 cm. Tail is about 1.5 times head-bodylength. Enlarged scales down middle of back interrupted by smaller scales. Skin fold on each side of body. Rusty area at base of tail. Light to dark gray above with a bluish tinge. 6-8 dark crossbands on back, interrupted medially and staggered. Edges of bars white or brown. Dusky line along sides from eye to groin. Bars on forelegs prominent. Head with intricate pattern.

MALE: Sides of belly from armpit to groin pale blue and may meet medially on belly. Throat pale green to blue or yellow-orange. Sides of throat, labials, chest, and ventral surface of legs suffused with gray and streaked with black. Preanal region and ventral surface of hind legs may be blue.

FEMALE: White ventral surface with blue dots scattered anteriorly and on sides of gular area. Elongate dark streaks on sides of abdomen and sometimes on chest, under tail, and ventral surface of hind legs. Throat white, yellow, or orange.

YOUNG: Resemble miniature brightly-patterned adults.

REPRODUCTION: Lays 1-6 clutches of 2-13 eggs March to August; hatch from July to late October.

STATUS: Not listed.

SPECIMENS:

Side-blotched Lizard (*Uta stansburiana*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Primarily fine or coarse-gravelly soil with rocks, burrows, and scattered low-growing bushes for cover. Found in sandy washes and flat areas. Common in all upland habitats at MOWE and MOCA.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 4-6 cm. Black to blue blotch on each side of chest behind foreleg. Dorsal pattern may be faint. Conspicuous dorsolateral lines.

MALE: No lateral light stripe. Dorsolateral stripes only on neck. Do dark blotches on back. Small black flecks scattered over dorsal surfaces and vertical yellow bars on sides extending dorsally to lateral stripe. Black axillary patch more vivid than female. Throat and lips barred with dark blue to gray. Throat ground color is light orange with blue area between gular folds that may be suffused with black. Belly and ventral surface of limbs and tail may be blue, but no distinct blue belly patches. Swollen tail base (Stebbins 1985, p 135).

FEMALE: Well-defined, continuous black-edged light stripe from posterior corner of eye onto tail. Area between dorsolateral and lateral stripes is brown with 2 irregular rows of small light blue flecks. Axillary patch faint. Gular area reticulated with blue or white specks. Shoulders and chest may be mottled. Lips barred.

YOUNG: 9 dark spots adjacent to black around light lateral stripe may not be distinguishable as distinct blotches. Dorsolateral stripes present and lateral light stripe discontinuous in juvenile males.

REPRODUCTION: Lays 1-3 clutches of 1-8 eggs March to August; hatching begins in July.

STATUS: Not listed.

SPECIMENS:

Short-horned Lizard (*Phrynosoma douglassii*)

RANGE: MOCA is included within the range, but few have ever been found on the monument. One was seen about 2 miles west of MOWE in early August 1993.

MOCA HABITAT: Primarily semi-arid plains with stony, sandy, or firm ground with fine loose soil: pinyon-juniper to shortgrass prairie habitats.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 4-11 cm. Short, stubby unerect horns and single row of fringe scales on each side of body. Deep notch in the back of the skull. Throat scales all small. Pair of large dark brown blotches on back of neck. Rear of throat and chest buff to yellow-orange.

REPRODUCTION: 5-36 young born July to September.

STATUS: Not listed.

SPECIMENS: 1 collected 2 miles west of MOWE not yet catalogued.

Family Gekkonidae

Western (Desert) Banded Gecko (*Coleonyx variegatus variegatus*)

RANGE: MOCA is included on the mid-eastern edge of the range.

MOCA HABITAT: Primarily areas, rocky areas, sand dunes, or near canyon walls, especially in creosotebush associations. Hides in rock crevices, under rocks, fallen logs, and litter. Several seen near cliffs at MOWE and MOCA.

ACTIVITY PERIOD: Nocturnal, likely to be seen at night crossing road. Maximum ACTIVITY is in May, between 80-84 degrees (Smith 1946, p 85).

IDENTIFICATION:GENERAL: 7-8 cm. Protruding eyelids. Light tan to yellow or pink with dark brown to black crossbands which break up with age into variegations and spots. Skin supple and dorsal scales uniformly granular. Vertical pupils. Tail constricted at base. Vocalization is a chirp. The subspecies C. v. utahensis, which has dark crossbands without light centers and with irregular margins, may also occur at MOCA (Miller et. al. 1982, p 55).

MALE: Prominent spur on each side of the base of the tail.

FEMALE: Larger than male.

YOUNG: Dorsal crossbands prominent, and spotting limited or absent.

REPRODUCTION: Lays 1-3 clutches of 2 eggs May to September. Eggs hatch in 45 days, July to November.

STATUS: Not listed.

SPECIMENS:

Family Teiidae

Gila Spotted Whiptail (*Cnemidophorus flagellicaudus*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Primarily in streamside growth and oak or pinyon-juniper woodlands. Found only at MOWE near Wet Beaver Creek as of September 1 1993.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 6-10 cm. 6 light gray stripes separated by dark brown bands, both with scattered light stripes. 3-6 scales between the two light stripes down middle of back. Tail light olive gray. 2 preanals.

YOUNG: No spots on dark bands.

REPRODUCTION: Parthenogenic.

STATUS: Not listed.

SPECIMENS:

Western (Arizona Desert) Whiptail (*Cnemidophorus tigris gracilis*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Primarily in open areas with sparse vegetation with firm, rocky, or sandy soil. Avoids dense grassland and thick shrubs. Found in woodlands and streamside growth. One of the most common lizards in all habitats at MOWE and MOCA.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 6-11 cm. Back and sides have spots, bars, or a network of dusky to black marks on a background of gray, yellow, or brown. 4-8 light stripes may be present and fade on lower back. Head, shoulders, and tail gray to brown or olive; bluish towards tip. Scattered black spots on venter, especially on chest and throat, which may also be black. Throat is orange to pink. Rust-colored patches on sides of body.

MALE:

FEMALE:

YOUNG: Spotted, marbled, and striped with black on an orange-yellow background above. Tail bright blue.

REPRODUCTION: Mates in April and May. Lays 1-2 clutches of 1-8 eggs April to August; hatch primarily from July to August.

STATUS: Not listed.

SPECIMENS: 1 from MOWE not yet catalogued.

Little Striped Whiptail (*Cnemidophorus inornatus*)

RANGE: MOCA is included within the range. Has not been confirmed on the monument as of September 1 1993.

MOCA HABITAT: Primarily on sandy, silty (sometimes gravelly) soil of low brushy flats and low mountain slopes. Will not occur in the same habitat as C. uniparens.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 5-7 cm. 6-8 light bands separated by dark red-brown to black bands on back. No dorsal spots. Throat and belly blue. Tail is brown at the base, with the rest bright blue interspersed with dark blue-grey bands. Vivid blue under tail. Postantebranchials granular and only slightly enlarged, as are scales in front of gular fold.

MALE: Darker blue belly.

FEMALE:

YOUNG: Belly less vivid blue.

REPRODUCTION: Mates in spring. Lays 2-24 eggs, May to July.

STATUS: Not listed.

SPECIMENS:

Desert Grassland Whiptail (*Cnemidophorus uniparens*)

RANGE: MOCA is included within the range. Behler and King (1979, p564) state that the range is expanding.

MOCA HABITAT: Primarily lowland desert, plains, and low foothill slopes in dense mesquite and yucca associations from 3500-5000 feet. Follows drainages into mountains. Found in grassy habitats at both MOWE and MOCA, but more common in a relatively wet grassy meadow at MOWE.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 5-8 cm. 6-7 dorsal stripes with black to red-brown fields between them. No light dorsal spots. Postantebranchials and gular scales enlarged. 3 enlarged, rounded preanals. Tail green-orange to blue-green.

YOUNG: Blue tail.

REPRODUCTION: Parthenogenic. Lays 1-4 eggs May to July; hatching begins in July.

STATUS: Not listed.

SPECIMENS: 1 from MOWE not yet catalogued.

Plateau Striped Whiptail (*Cnemidophorus velox*)

RANGE: MOCA may not be included in, or may be on the northwestern edge of, the range. Has not been confirmed on the monument as of September 1 1995.

MOCA HABITAT: Primarily in broadleaf woodlands along permanent streams, in pinon-juniper or oak woodlands, or in grasslands; from 5,500-6000 feet.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 6-8 cm. 6-7 light stripes separated by dark brown to black bands. Usually no dorsal spots, but may have a few circular light spots in dark fields. Postantebranchials and gular scales enlarged. More than three enlarged, triangular preanals. Throat whitish and chin blue-grey. Belly white to pale blue-grey. Tail light blue.

YOUNG: Bright blue tail.

REPRODUCTION: Parthenogenic. Lays 3-5 eggs June to July; hatch in August.

STATUS: Not listed.

Family Anguidae

Arizona (Madrean) Alligator Lizard (*Gerrhonotus kingi nobilis*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Primarily in rocky areas, near streams or along broadleaf stream borders. Lowe (1964) discovered one in a riparian woodland area of desert grassland at 2400 feet. Also found at cliff bases and pine-chaparral to dry grasslands. Shelters under logs, rocks, leaf litter, in woodrat nests, and in or near dense plant growth. Common in riparian and near housing areas at both MOWE and MOCA.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 8-13 cm. tail is 2 times body length. Head narrow and flattened. Ashy light brown to grey-olive background and paler on sides. 9-12 continuous broad bands of darker brown on neck and body. Posterior borders have black borders with white tips on scales. Black and white spots on upper jaw. Lateral folds on sides. Square, shiny scales. Eyes light orange or pink.

YOUNG: Contrasting dark crossbars on back and tail. Head and body are more depressed and lateral fold is not as obvious as in adults.

REPRODUCTION: Lays 9-12 eggs in June or July; hatching begins in July.

STATUS: Not listed.

SPECIMENS: #2727 at the Museum of Northern Arizona, collected at MOWE on 7/26/72 by T.R. Huels.

Family Helodermatidae (venomous)

Reticulate Gila Monster (*Heloderma suspectum suspectum*)

RANGE: MOCA is on the northern edge of the range. Gila Monsters were not found on or near the Monument during our surveys, however there are historical records of its occurrence at MOCA.

MOCA HABITAT: Primarily in sandy areas with scattered brush near rocky buttes and streams, including lower mountain slopes, valleys, and broad canyons. Found in creosotebush, mesquite, ocotillo, grassy, and succulent associations, typically near woodrat nests, burrows, and dense thickets. Also found in irrigated areas (Stebbins 1985, p 170).

ACTIVITY PERIOD: Primarily nocturnal, but diurnal during warm winter and spring days (Behler and King 1979, p 546). Peak ACTIVITY is from March to June. Hibernate in winter, but will bask on warm days from January to March.

IDENTIFICATION:GENERAL: About 35 cm. Cylindrical body with fat and heavy tail. Coarsely reticulated, irregular pattern of brown or black marks on a yellow, pink, or orange background. 4 dark rings on tail. Limbs black. Tubercle-like scales give a beaded look. Neurotoxic venom.

MALE: Larger and wider head than female.

FEMALE:

YOUNG: 16 cm at hatching. Distinct dorsal bands with circular cutouts.

REPRODUCTION: Mate April to June. Lays 1-12 (usually 4-6) eggs from July to August. Eggs hatch in fall; young may overwinter in nest (Lowe et. al 1986, p 16).

STATUS: Not listed, but range is decreasing and populations are falling.

SPECIMENS:

Family Colubridae

Glossy Snake (*Arizona elegans*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Primarily in burrows in open areas with sandy or loamy soil and light shrub cover, and also grasslands to woodlands. Seen in damper habitats at MOCA.

ACTIVITY PERIOD: Nocturnal.

IDENTIFICATION:GENERAL: 66-178 cm. Resembles a bleached gopher snake. Light brown to pink or grey above with tan, brown, or grey blotches edged with black. White to buff below without markings. Dorsal scales glossy and smooth. Pupils slightly vertical and dark eye. Tail short. Single anal.

YOUNG:

REPRODUCTION: Mates in spring. Lays 2-23 eggs in summer; hatch in 10-12 weeks.

STATUS: Not listed.

SPECIMENS:

Sonoran Gopher Snake (*Pituophis melanoleucus affinis*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Found on hardpan, sand, loam, or rocky soil in a variety of habitats: desert, prairie, brush, and woodland. May be found in burrows or in trees (Shaw and Campbell 1974, p 113). Often seen near the MOCA visitor center.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 90-275 cm. Yellow to cream with black, brown, or red-brown dorsal blotches with smaller secondary blotches on the sides. Blotches darken

posteriorly on the body. Dark line across head in front of eyes, and from behind eye to angle of jaw. White to yellow venter spotted with black. Dorsal scales keeled. Anal single. Tail thin and tapers to a point. Large gopher snakes are likely to hiss loudly, vibrate the tail, and strike repeatedly when cornered.

YOUNG: Like miniature adults.

REPRODUCTION: Lays 1-2 clutches of 2-24 eggs June to August.

STATUS: Not listed.

SPECIMENS:

Night Snake (*Hypsiglena torquata*)

RANGE: MOCA is included within the range. Has not been confirmed on the monument as of September 1 1993.

MOCA HABITAT: Primarily in rocky or sandy areas in grassland, thornscrub, or woodland. Often found under rocks or in rock crevices, under boards, or under other surface litter.

ACTIVITY PERIOD: Nocturnal.

IDENTIFICATION:GENERAL: 30-65 cm. pale gray, light brown, or beige with dark gray or brown blotches on back and sides. Pair of dark brown blotches on neck. Black to dark brown bar behind eye and whitish upper labials. Cylindrical body with flat head. Vertical pupils. Scales smooth. Divided anal. Belly yellow to white. Saliva mildly venomous.

YOUNG:

REPRODUCTION: Lays 2-9 eggs April to August; hatch in 7-8 weeks.

STATUS: Not listed.

SPECIMENS:

Western (Sonoran) Lyre Snake (*Trimorphodon biscutatus lambda*)

RANGE: MOCA is included within the range. One found about 1 mile north of MOWE.

MOCA HABITAT: Primarily in rocky areas of hillsides, slides, canyon, boulder-strewn lower mountain slopes. Frequents large rocks in creosotebush desertscrub and pinon-juniper woodlands. Often found in crevices and under flakes of large rocks (Shaw and Campbell 1974, p 169).

ACTIVITY PERIOD: Nocturnal.

IDENTIFICATION:GENERAL: 45-121 cm. Slim with large yellow eye with vertical pupil. Broad head on thin neck. Chevron-shaped head marks. Less than 22 dark brown or gray saddle-shaped blotches with light centers and smaller secondary blotches on sides and belly. Ground color light brown to gray. Anal divided. Scales smooth. Coils defensively and vibrates tail (Shaw and Campbell 1974, p 170). Slightly venomous, but rear-fanged and not considered dangerous.

YOUNG:

REPRODUCTION: Lays 7-20 eggs in late summer.

STATUS: Not listed.

SPECIMENS:

Ground Snake (*Sonora semiannulata*)

RANGE: MOCA is included within the range. Has not been confirmed on the monument as of September 1 1993.

MOCA HABITAT: Primarily in dry open areas with loose sandy soil or sand hummocks, including rocky and wooded areas, hillsides, and mesquite thickets along riverbeds.

ACTIVITY PERIOD: Nocturnal.

IDENTIFICATION:GENERAL: 20-50 cm. Glossy. small dark blotch on front of dorsal and lateral scales. Color highly variable: no pattern, one wide red, orange, or tan dorsal stripe, crossbands encircling body, 1 neck band, or saddle-shaped blotches. Snout not flattened and lower jaw not underset. White to yellow venter. Divided anal.

YOUNG: 10-13 cm at hatching (Behler and King 1979, p 653).

REPRODUCTION: Mates in spring and fall. Lays 4-6 eggs early June to late August; hatch in 7-10 weeks.

STATUS: Not listed.

SPECIMENS:

Western Long-nosed Snake (*Rhinocheilus lecontei lecontei*)

RANGE: MOCA is included on northern edge of the range.

MOCA HABITAT: Primarily in dry open prairie and desert brushland to 5400 feet. May be found in irrigated areas (*Sha*w and Campbell 1974, p 126). One found in creosote-rabbitbrush association at MOCA.

ACTIVITY PERIOD: Nocturnal.

IDENTIFICATION:GENERAL: 50-104 cm. Light-colored, cream-flecked black saddle-shaped blotches extend down sides to edge of belly scales. Spaces between blotches are pink or red. Black spots on the sides. Single anal. Scales under tail in single row. Tapered, pointed snout that protrudes beyond lower jaw. Head only slightly wider than neck. Bizarre defense reaction: Hides head in coils, vibrates tail, and discharges blood and anal gland secretion from cloaca.

YOUNG: 20-25 cm at hatching. Speckling on sides faint or absent.

REPRODUCTION: Mates in spring. Lays 1-2 clutches of 4-9 eggs June to August; hatching begins in August.

STATUS: Not listed.

SPECIMENS:

Sonoran (Arizona Mountain) Kingsnake (*Lampropeltis pyromelana pyromelana*)

RANGE: MOCA is included within the general range of this species, but we did not record it in or near the Monument during our surveys.

MOCA HABITAT: Often near streams and springs in areas with rocks, hollow logs, and dense vegetation clumps. In pinon-juniper woodlands, shrubland, brushy rocky canyons, and talus slopes from 2800 feet.

ACTIVITY PERIOD: Probably diurnal (Behler and King 1979, p 621), and nocturnal on warm nights (Shaw and Campbell 1974, p 123).

IDENTIFICATION:GENERAL: 45-104 cm. Red, black, and white banded with wide, flat head. Red forms a wedge on each side of black bands or splits black bands completely. Black bands become narrow and disappear on sides. Snout white, yellow, or black flecked with white. Single anal. Bands are complete across belly less than one-half of the body length. Most of scales under tail are in double row.

YOUNG: 8-10 cm at hatching (Behler and King 1979, p 621).

REPRODUCTION: Mates in spring. Lays 3-6 eggs June to July; hatch in 2.5-3 months.

STATUS: Not listed, but possibly declining due to over-collection.

SPECIMENS:

Common (California) Kingsnake (*Lampropeltis getulus californiae*)

RANGE: MOCA is included within the range.

MOCA HABITAT: In a variety of habitats including river bottoms, rocky wooded hillsides, and deserts, in the vicinity of rock outcrops, vegetation clumps, and under lumber and rotting logs. Seen in all habitats at MOCA and MOWE.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 75-208 cm. May be banded with dark brown or black above with 21-44 white or yellow dorsal bands that extend to or onto belly, and brown or dusky pigment may be present on bases of scales of light crossbands. May also be dark brown or black above with white to cream mid-dorsal stripe and lateral stripes formed by a series of light-centered scales, or intermediately colored: light speckling on a dark background. Single anal. When disturbed, rolls into a ball with head buried and everts the vent lining (Stebbins 1985, p 193).

YOUNG: 27-30 cm at hatching (Behler and King 1979, p 619). Blotched at first and turning spotted with age.

REPRODUCTION: Mates March to June. Lays 2-24 eggs May to August; hatch in 8.5-11.5 weeks.

STATUS: Not listed.

SPECIMENS:

Western Patch-nosed Snake (*Salvadora hexalepis*)

RANGE: MOCA is included on the northern edge of the range.

MOCA HABITAT: Primarily in sandy and rocky areas on lower mountainslopes and in creosotebush desert flats. Also in pinon-juniper woodlands and grasslands. Common in all habitats at MOCA and MOWE.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 55-115 cm. Gray to tan with wide triangular-shaped rostral scale curved back over snout. Broad beige to yellow dorsal stripe bordered by dark side stripes. 9 upper labials. Top of head gray. Divided anal. Large eye. Venter washed with dull orange especially towards tail.

MALE: Keeled scales above vent and at base of tail.

FEMALE: Vent and tail scales weakly keeled or all smooth.

YOUNG:

REPRODUCTION: Mates in April to June. Lays 4-10 eggs May to August; hatch in 2-3 months.

STATUS: Not listed.

SPECIMENS: 1 from MOWE not yet catalogued.

Regal Ringneck Snake (*Diadophis punctuatus regalis*)

RANGE: MOCA is included within a northwestern range extension into Arizona.

MOCA HABITAT: Primarily moist habitats of mountains and watercourses, including woodlands and riparian areas of desert scrub. May follow canyon stream course down to 2400 feet (Stebbins 1985, p 175). Often found under bark, rocks or in rotting logs. Found in sycamore riparian habitat at MOWE and near the well at MOWE.

ACTIVITY PERIOD: Primarily crepuscular or nocturnal.

IDENTIFICATION:GENERAL: 20-75 cm. Slim brown, blue-gray, or black with a dark head. May have conspicuous yellow, orange, or cream neck band. Yellow-orange to red with black spots below, and intense red under tail. Displays coiled undertail when alarmed. Saliva mildly venomous but gape is very small.

MALE: Prominent tubercles on scales above vent.

FEMALE:

YOUNG: Dark brown to black above. 10-15 cm at hatching.

REPRODUCTION: Mates spring or fall (Behler and King 1979, p 600). Lays 1-2 clutches of 1-10 eggs June to July; hatch in about 8 weeks.

STATUS: Not listed.

SPECIMENS:

Red Coachwhip (Red Racer) (*Masticophis flagellum piceus*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Found in a variety of dry open areas that are flat, hilly, sandy, or rocky: mesquite, creosotebush, thornforest, and juniper-grassland. Miller et. al. (1982, p 91) suggest that thick vegetation cover may be preferred. Shelters in rodent burrows, among rock, or in bushes.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 90-255 cm. Red to pink above, often grading to tan on tail. Wide black, brown, or pink crossbands on neck and foreparts of body may be faint. May also be completely black above. Dark spots at base of dorsal scales (Wilson 1973, p 145.1). Pale below becoming salmon-pink to red toward tail. No well-defined lengthwise stripes. Anal divided. Smooth scales. May interbreed in the monument area with Masticophis flagellum testaceus, which has a double row of dark spots on a cream belly (Wilson 1973, p 145.3). 17 dorsal scale rows at mid-body.

YOUNG: Dark crossbands on dorsal surface. 30-41 cm at hatching (Behler and King 1979, p 629).

REPRODUCTION: Mates in April and May. Lays 4-20 eggs June to July; hatch in 6-11 weeks.

STATUS: Not listed.

SPECIMENS: 1 collected about 0.5 miles west of MOWE not yet catalogued.

Desert Striped Whipsnake (*Masticophis taeniatus taeniatus*)

RANGE: MOCA is included on mid-southern edge of the range.

MOCA HABITAT: Primarily rocky stream courses in shrublands, canyons, and pinon-juniper woodlands. Shelters in rock outcrops, rodent burrows, and often in trees and shrubs. Seen in open habitats at MOCA.

ACTIVITY PERIOD: Diurnal, active during the hotter part of the day (Miller et. al. 1982, p 93).

IDENTIFICATION:GENERAL: 90-138 cm. Black, dark brown, or gray above, often with olive-blue cast. Cream or white stripe on each side is bisected by a black line. Black lines also on lower sides. Yellowish below, grading to white anteriorly and to pink posteriorly. Large head scales edged in white. Divided anal. 15 dorsal scale rows at mid-body.

YOUNG: 36-43 cm at hatching (Behler and King 1979, p 631).

REPRODUCTION: Mates in spring. Lays 3-12 eggs June to July; hatch in August.

STATUS: Not listed.

SPECIMENS:

Western Black-necked Garter Snake (*Thamnophis cyrtopsis cyrtopsis*)

RANGE: MOCA is included on the western edge of the range.

MOCA HABITAT: Primarily near permanent and intermittent streams, irrigation canals, and spring seepages in mountain foothills, mesquite flats, grasslands, and canyons. In wet weather will wander from streamside (Stebbins 1985, p 209). Often found basking along rocky or heavily vegetated streamsides (Behler and King 1979, p 666). Found in a variety of habitats at MOWE and MOCA.

ACTIVITY PERIOD: Diurnal.

IDENTIFICATION:GENERAL: 40-107 cm. White to yellow mid-dorsal stripe separates 2 large black blotches at the back of the head. White crescent between each blotch and corner of the mouth. Lateral stripe often wavy. 2 alternating rows of black spots between stripes often fade at mid-body. 7-8 upper labials. Anal single.

YOUNG: 20-25 cm at birth (Behler and King 1979, p 666).

REPRODUCTION: 7-25 young born June to August.

STATUS: Not listed.

SPECIMENS:

Family Elapidae (venomous)

Western (Arizona, Sonoran) Coral Snake (*Micruroides euryxanthus euryxanthus*)

RANGE: MOCA may be included on the northern edge of the range. Historical records occur for MOCA.

MOCA HABITAT: Primarily on rocky, gravelly soils or sandy loams under desert shrubs (Lowe 1986, p 29). Found mainly in rocky upland desert, arroyos, and river bottoms among rocks, but also on lower mountain slopes and plains. Vegetation associations include thornscrub, brushland, woodland, and grassland. Found distributed with blind snakes, which are their primary prey (Lowe 1986, p 28).

ACTIVITY PERIOD: Primarily nocturnal in summer. Seen diurnally and nocturnally in spring and fall, and after rainfall (Lowe 1986, p 25).

IDENTIFICATION:GENERAL: 33-53 cm. Thin and flattened with a blunt snout and head black to the eyes. Alternating broad red and thin black rings separated by narrow white or yellow rings. Anal divided. Display includes elevating and waving the tail and everting the vent lining with a popping sound.

REPRODUCTION: Lays 2-3 eggs during the summer rains; hatch about September.

STATUS: Not listed.

SPECIMENS:

Family Viperidae (venomous)

Western Diamondback Rattlesnake (*Crotalus atrox*)

RANGE: MOCA is included in northwest edge of the range. Lowe (1986, p 53) states that this species occurs south of the Mogollon Rim.

MOCA HABITAT: Primarily in sparsely vegetated mesquite or grassland foothill areas along rock outcrops, river bluffs and rocky canyons. Also in dense (oak) riverbottom and desert shrubland growth (Ernst 1992, p 93). In all habitats at MOCA and MOWE.

ACTIVITY PERIOD: Diurnal in spring and fall, and nocturnal or crepuscular in summer (Ernst 1992, p 95). Active April to October (Ernst 1992, p 95), then hibernates in a rock crevice or cave on a south-facing slope.

IDENTIFICATION:GENERAL: 86-213 cm. Tail encircled with broad black and white rings about equal in width. Black ring is 3 or more scales wide (Ernst 1992, p 144). Back has light-bordered diamonds or hexagonal blotches partially obscured by small dark spots. 2 light diagonal lines on sides of face behind eye meet upper lip well in front of the angle of the jaw.

YOUNG: More distinct markings. 22-33 cm at birth.

REPRODUCTION: Mates March to May and in fall prior to hibernation. four - 25 young born in late summer and fall every other year (Ernst 1992, p 95).

STATUS: Not listed.

SPECIMENS:

Mojave Rattlesnake (*Crotalus scutulaus scutulatus*)

RANGE: MOCA is included in the eastern edge of the range. We collected a road-killed Mojave Rattlesnake very near the boundary of Montezuma Well. We have not seen this species in or near Montezuma Castle and, based on road surveys and general surveys, it is much less common in the general vicinity of the Monument than the similar-appearing Western Diamondback Rattlesnake.

MOCA HABITAT: Primarily in upland desert, arid lowlands, grassy plains, and rocky foothills with sparse scrubby vegetation. Often found in mesquite and creosotebush near streambeds or on the bank of a dry wash. Seems to avoid dense vegetation (Lowe, p 56). Shelters in rodent burrows, packrat nests, and under surface debris (Lowe 1986, p 54).

ACTIVITY PERIOD: Primarily nocturnal, but with low ambient temperatures may be active diurnally in the summer.

IDENTIFICATION:GENERAL: 61-130 cm. Uniform white scales around diamond-shaped blotches on back. Green-gray, olive-gray, green-brown, or yellow above. Black and white rings on tail, with white ring proportionally much larger (at least twice as large as black rings, Lowe 1986, p 54): black rings are two or less scales wide (Ernst 1992, p 144). Two internasals. Two large scales on top of head between the supraoculars.

YOUNG: 23-28 cm at birth.

REPRODUCTION: Breeds late February to May; 2-11 young born July to August.

STATUS: Not listed.

SPECIMENS:

Western (Arizona Black) Rattlesnake (*Crotalus viridus cerberus*)

RANGE: MOCA is included within the mapped range of this species, and Ernst (1992, p 155) noted that specimens were recorded from Yavapai County. We have not recorded this species in or near Montezuma Castle or Montezuma Well, in spite of extensive road driving at night that should have located it, if it was present.

MOCA HABITAT: Primarily in rocky outcrops, talus slopes, stony canyons, and rocky stream courses with conspicuous and dense woody cover. Found in a variety of habitats including prairie, woodland, and scrubland.

ACTIVITY PERIOD: Becomes crepuscular and nocturnal during the summer. Active April to September (Ernst 1992, p 164).

IDENTIFICATION:GENERAL: 41-163 cm. Brown polygonal blotches down middle of back edged with dark brown or black and surrounded by a lighter border of white scales. Blotches tend to narrow into conspicuous crossbands near tail. Yellow to white crossbars. May also be nearly solid black or with poorly defined saddle-shaped blotches in this area (Stebbins 1985, p 232). Light stripe behind eye to corner of mouth. More than two internasals, generally four.

YOUNG: 15-30 cm at birth.

REPRODUCTION: Mates March to May and in the fall. 1-25 (frequently 4-12) young born August to October. May hybridize with *C. scutulatus* (Ernst 1992, p 164).

STATUS: Not listed.

SPECIMENS:

Northern Black-tailed Rattlesnake (*Crotalus molossus molossus*)

RANGE: MOCA is included within the range.

MOCA HABITAT: Primarily in rocky streambeds, wooded stony canyons, rockslides, rock outcrops and cliffs in cactus-thornbush and mesquite-grass associations. Will climb into bushes (Ernst 1992, p 132). Seen near cliffs at MOCA.

ACTIVITY PERIOD: Primarily nocturnal, but diurnal on cooler summer days. Primarily active April to October (Ernst 1992, p 132). More commonly seen in late summer and fall.

IDENTIFICATION:GENERAL: 70-126 cm. Black tail and often black snout, contrasting with the rest of the body. Tail may be grey with vague rings. Back with brown or black irregular blotches or crossbands, each edged with white and a single or double patch of light scales at the center. Anterior dark marks may be triangle shaped. Scales unicolor within color patches. Enlarged scales on upper surface of snout. Light border dark stripe from eye to corner of mouth and dark band between eyes (Ernst 1992, p 129). Generally very passive.

YOUNG: Dark rings on tail. About 27 cm at birth.

REPRODUCTION: 3-16 young born July to August.

STATUS: Not listed.

SPECIMENS:

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MISCELLANEOUS TIPS:

- All juveniles have proportionally large heads for their body size.

- Most reptiles bask in the early morning and are active until the heat of the day forces them into rock crevices or under rocks, burrows, loose soil, or the shade of a bush. They become active again in late afternoon or evening, until the night temperature becomes too cool. On warm summer nights many normally diurnal species are active after dark.

- The monsoon season, mainly July and August, appears to be the best time of year to discover the most species of reptiles and amphibians on roads at night.

**Appendix 2**: Reptile and amphibian specimens collected during Montezuma Castle inventory project, December 1993 - February 1996 (all specimens are housed at the Biology Museum, Northern Arizona University, Flagstaff, AZ, or at the Museum of Southwestern Biology, Albuquerque, NM).

AMPHIBIANS

| | |
|---|---|
| Bufo woodhousei | 3 immatures |
| Rana catesbiana | 1 tadpole |

LIZARDS

| | |
|---|---|
| Cophosaurus texanus | 2: 1 adult, 1 immature |
| Crotaphytus collaris | 2: 1 adult, 1 immature |
| Phrynosoma douglassi | 1 adult |
| Uta stansburiana | 1 adult |
| Sceloporus clarkii | 1 adult |
| Sceloporus magister | 2 adult |
| Cnemidophorus flagellicaudus | 3 eggs (frozen) |
| Cnemidophorus tigris | 2: 1 adult, 1 immature |
| Cnemidophorus uniparens | 1 adult |

SNAKES

| | |
|---|---|
| Arizona elegans | 2 adults |
| Masticophis bilineatus | 1 adult |
| Masticophis flagellum | 2: 1 adult, 1 immature |
| Pituophis melanoleucus | 1 immature |
| Rhinoceilus lecontei | 1 immature |
| Salvadora hexalepis | 3: 2 adults, 1 immature |
| Sonora semiannulata | 1 adult |
| Diadophis punctatus | 1 adult |
| Hypsiglena torquata | 1 immature |
| Crotalus atrox | 2 adults |
| Crotalus scutulatus | 2 adults |

Slides of Montezuma Castle amphibians and reptiles (in lieu of specimens):

Hyla arenicolor

Chrysemys picta
Kinosternon sonoriense

Urosaurus ornatus
Cnemidophorus velox
Cnemidophorus uniparens
Gerrhonotus kingii (adult and immature)
Coleonyx variegatus

Rhinocheilus lecontei (adult)
Lampropeltis getulus (immature)
Thamnophis cyrtopsis
Trimorphodon biscutatus
Micruroides euryxanthus
Crotalus molossus