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Why Did The Gila Monster Cross The Road?
Basic Research at Tonto National Monument

2004 Annual Report (Grant # 04-15)
and 2005 Initial Progress Report (Grant # 05-12)
to Western National Parks Association

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Introduction

Gila monsters (*Heloderma suspectum*) are a flagship species of the Sonoran Desert. They are one of the more easily recognizable and charismatic reptiles living in the southwestern National Parks. In spite of this, these large lizards are rarely seen and poorly understood. Several studies have estimated that they may spend up to 95% of their active season underground (Beck 1990 and J. Davis, pers. comm.). Tonto National Monument in central Arizona is unusual in that numbers of gila monsters may be found with some predictability during the spring. A majority of the gila monsters seen at the park were crossing the main road near the pump house, but the reasons for these observations have been unclear. A program to identify individual gila monsters based on differences in dorsal pattern from photographs was begun in1994, but no additional studies of the species have taken place at Tonto.

In 2004, we completed the first year of a two-year mark-recapture and telemetry study of gila monsters at Tonto National Monument. Our study has the following objectives: 1) Initiate long-term mark-recapture studies with permanent identification of individual gila monsters using PIT-tagging; 2) continue photographing the dorsal patterns of animals and compare these and previous photos to PIT-tagged individuals to assess the efficacy of the photographic identification method; 3) surgically implant radio-transmitters in up to five adult gila monsters to assess movement patterns and habitats used (especially to provide an answer to the question of why gila monsters cross the road by the pumphouse), and basic ecological information; and 4) provide interpretive research sessions for visitors.

This report will cover the results from fieldwork in 2004 (Grant #04-15) and progress to date in 2005 (Grant #05-12). Final scientific and layman reports will be delivered in 2006.

2004 Results

Methods

Capture and PIT-tagging. We searched for gila monsters in Cave Wash, the park housing, and the pumphouse area intensively in the spring (March-April) and monsoon period (July-August). Gila monsters were also captured opportunistically by park staff. All researchers and park staff received training on capturing gila monsters from experts from Arizona State University in April 2004. When a gila monster was detected, we recorded capture location, UTM GPS coordinates in the NAD 27 Datum, ambient temperature, weather conditions, and direction of travel.

Gila monsters were initially captured using reptile tongs. They were held until processing (no more than 24 hours) in locking plastic buckets designed for handling venomous reptiles. All gila monsters were weighed and measured, including snout-vent length (SVL) and tail length. Gila monsters were sexed using visual observation of head size and hemipene extrusion (for example, by injecting saline into the cloaca; D. DeNardo, pers. comm.); however this method did not always work and some gila monsters were not sexed. Starting in fall 2004, tail volume was also measured by water displacement from a plastic beaker. This measure is an index of overall condition of the animal because gila monsters store fat in their tails (Lowe et al. 1986).

For permanent identification, we injected a small (11 to 12 mm) glass-encapsulated passive integrated microchip transponder (PIT tag) into each gila monster (Fagerstone and Johns 1987). These tags last for the lifetime of their host animal, and may be scanned at a distance of three to six inches to produce a unique identification code. When properly injected, PIT tags have been shown not to cause adverse effects to small vertebrates and have low failure rates (0-1%) (Keck 1994, Camper and Dixon 1988). Using sterile techniques, we or a veterinarian injected a tag into the muscle of the upper back leg or pelvic area of each gila monster (D. DeNardo, unpubl. method). Every time a gila monster was captured we scanned it with a tag scanner to verify its identity. No more than 24 hours after initial capture, the animal was released at its original capture point. Each capture and release of a gila monster in a public area was used as an interpretive opportunity to explain to visitors the project's objectives, funding source, and results, as well as gila monster biology and behavior.

Photograph Comparisons. When captured initially, the back of each gila monster was photographed using digital or 35-mm cameras. Photographs were taken from the top at a distance of 3 feet or less, so that the animal filled the frame. As well, photographs were taken of the venter of each animal. Photo records were printed and archived at the park resource management office in a notebook. Additional digital images of gila monsters taken at Tonto from 1994-1997 (provided by D. Swann) were printed and added to this notebook. Each new animal captured was compared to existing photographs to see if it had been previously caught.

Telemetry. Radio-transmitters were implanted in male or non-gravid female adult gila monsters. Transmitters weighed 13-20 grams (no more than 5% of each animal's body weight), and had a life expectancy of about 2-3 years. Surgeries occurred in a sterile

laboratory at Arizona State University, and were performed by a veterinarian expert in gila monster transmitter implantation. Methods for preparation and surgery followed those of Hardy and Greene (1999) for rattlesnakes (modified by D. DeNardo for gila monsters). Transmitter implantation occurred in the coelomic (gut) cavity of the lizards with the antenna wire coiled subcutaneously toward the head. After surgery, the lizard was given an injection of saline equal to 5% of the body weight to ensure replacement of any fluids lost during or after surgery. There was a 2-6 hour post-operative recovery period, after which they were returned to their original capture site. Their positions were determined using telemetry at least twice a week during the active period and once a month during the hibernation season. When an animal was located, we recorded its position in UTMs (NAD 27 Datum), time, date, weather conditions, microhabitat association, behavior, and whether a visual sighting was obtained.

Movement patterns and habitat use will be mapped using ArcView 3.3 and analyzed using ArcView extensions (e.g. Animal Movement and Spider). To date, all data for 2004 and winter 2005 has been entered but mapping and analyses have not occurred.

Results and Discussion

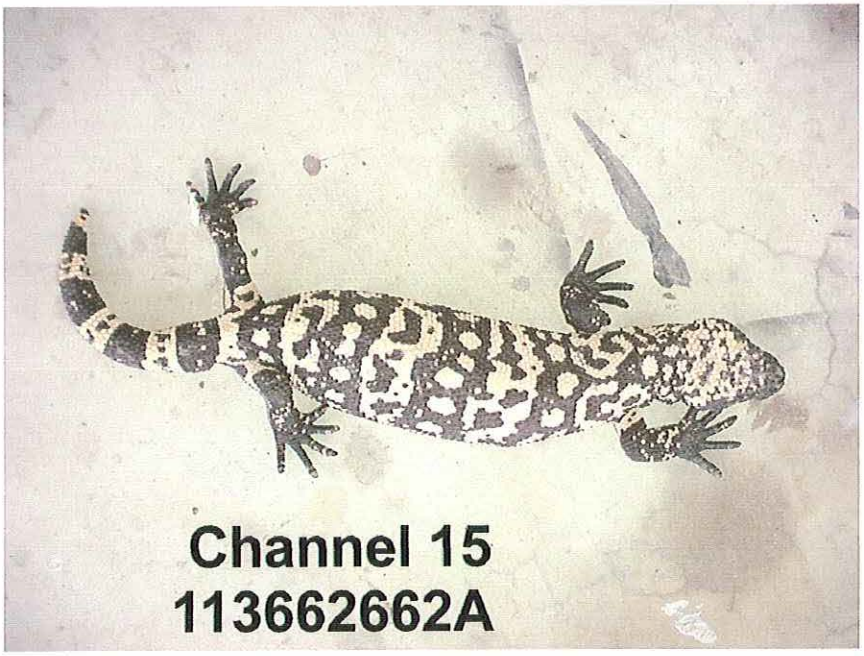
We captured and PIT-tagged a total of nine gila monsters at Tonto in 2004 between March 20 and May 17, and one was recaptured on July 4. Sexing gila monsters has proven to be difficult, especially in very young animals. We estimate that we have captured five adult males, one adult female, and two subadults and one juvenile of unknown sex.

Six adult gila monsters were implanted with radio-transmitters. Of these, five were likely males and one was a female. We obtained a total of 255 locations of these animals between April 2004 and January 2005. One gila monster disappeared in June 2004 and we are not sure if the transmitter failed, he moved out of range, he was killed and carried away, or if he was poached from the park.

Photograph comparisons. Using photographs taken previously, we were able to document the recapture of at least three gila monsters. The first, a long-term recapture, was male Channel 15. He was initially captured by wildlife biologist Don Swann (currently of Saguaro National Park) as a small adult or subadult in May 1995. The dorsal photograph taken at that time matches closely (if not perfectly) a photograph taken on April 24, 2004 (Figure 1a and b). This result is significant because it shows the potential efficacy of using non-invasive photography as a long-term mark-recapture method. As well, it gives us a longevity record of at least 12 years for a gila monster in the wild. One other published record is of a gila monster living 32 years in captivity (Cooper and List 1979).

The second, male Channel 00, was also captured several times before the present research started. He was photographed first as a small adult or subadult in 2002, and then again in 2003. In April 2004 he was captured as an adult. In all three captures he was found in similar locations in the housing area.

1a. 1994 or 1995



1b. 2004

Figure 1a-b. Photographs of a male gila monster captured at Tonto National Monument, Arizona in 1994 or 1995 (**1a**) and recaptured during WNPA-funded surveys in 2004 (**1b**). Animal was originally captured as a subadult by Don Swann in 1995.

The third animal, a juvenile subsequently named "Star" by park staff, was originally captured on March 20 before PIT tagging efforts commenced. It was captured again on April 9 and PIT-tagged. Matching photographs from the initial capture indicated that it was a recapture. This animal was recaptured at least eight times in different locations

along the park road between the visitor center and park housing between March 20 and July 4.

Activity Period and Preliminary Movement Data. Gila monsters apparently began emerging from hibernation at Tonto in late March 2004, as the first animal was detected on March 20. The major emergence and/or dispersal period appeared to be the first two weeks in April, with a peak on April 9, when five were detected during surveys with volunteers. Three of the gila monsters detected on April 9 were near or crossing the main park road in a single location just below (north of) the visitor center parking lot. Two (a subadult and an adult) were captured under the exact same bush less than a half-hour apart.

Habitats used by the telemetered gila monsters covered the entire monument, but they seemed to prefer washes and rocky outcrops or hillsides. Shelter sites were typically monster-excavated burrows under boulders or small rock outcrops. As expected, these lizards were frequently located underground: we did not obtain a visual fix in 186 of 255 (73 %) locations of the telemetered animals.

Although new detections ended in May, "Star" was recaptured on July 4. Although exact movements are not yet plotted and analyzed, we found that most detections of moving animals occurred in April and May, with a second peak in early September. Gila monsters tended to be diurnal during April, May, September, and October, and nocturnal or crepuscular during the hotter summer months. It was not uncommon for individuals to move a few hundred meters a week, much to the exasperation of technicians Justin Schofer and Amyann Madara. Amyann followed the signal for male Channel 15 for 2 hours on May 26 as he was moving until she was able to get a visual sighting of him (pers. comm.). Telemetered gila monsters continued to move sporadically between retreat sites until the end of October or early November, when the hibernation period began.

Prey and Water. We have observed gila monsters with hair around their mouths, and from conversations with other experts, we assume that they have been eating young cottontail rabbits (J. Davis, pers. comm.). One rabbit was seen near a gila monster but no interaction could be established between them. A second animal regurgitated a freshly-eaten, unbroken clutch of six Gambel quail eggs when captured.

One of the telemetered gila monsters was found drinking from a leaking hose in the housing area on April 29. This observation is important as it shows that they will drink free water and are using human-modified habitats and features to obtain basic ecological needs.

Behavior. We did not observe any interactions between gila monsters. An unexpected behavioral interaction with human researchers is that telemetered animals exhibited a range of defensive behaviors when located. Of 69 visual observations, the telemetered animal did not visibly react when detected in just over half of the cases (n=35 observations, or 51%). This is consistent with our findings with telemetered rattlesnakes at Tonto and Montezuma Castle National Monuments. During the remaining observations, gila monsters usually moved under cover, ran away, or retreated deeper into a burrow (46%) and two froze without moving (3%). In addition to actively moving

away, they also tongue-flicked (11% of observations), hissed (3%), or showed the inside of the mouth through gaping (1%).

Why DID the gila monster cross the road? We suspect that gila monsters are commonly seen near visitor center area and along the road in early spring as they are dispersing from hibernation sites higher up in the cliffs. This area parallels Cave Wash and locations here where we have seen gila monsters tend to be covered by dense vegetation. We measured humidity at 33% at the site where the three animals were found on April 9. This value would appear to be high for a sunny day with 25% cloud cover and an air temperature of 25° C. Gila monsters have been documented to seek out humid microsites for denning during the active season (D. Beck 1990, pers. comm.), so it is possible that by following Cave Wash they are staying within preferred microclimates. It is also possible that they are following a traditional social migration route used over generations (e.g. Ford 1986). In this hypothesis, by following the scent trails of others, adults increase chances of finding mates and juveniles increase chances of finding areas with rich food resources that adults have found previously. To our knowledge the role of pheromone trails in the social behavior of gila monsters has not been studied.

Management Implications

Gila monsters were commonly sighted at Tonto during the spring months (especially in early April) in human-modified habitats, either crossing the road, in the visitor center area, or in the housing area. One adult was found dead on the road near the pump house in 2003. Given that the species is of special interest to the park, placing cautionary signs along the road before and after the known crossing zone (above the picnic area to the visitor center) in the spring might help decrease road mortality and raise visitor awareness. Interpretive programs could also be given during these months. On peak emergence days in early April when more than one gila monster is sighted, a volunteer working the road crossing zone could assist with detections and successful crossings.

Park staff should be aware of the potential for illegal poaching, as gila monsters command a high price on the black market (R. Babb, Arizona Game and Fish Law Enforcement, pers. comm.). In fact, it is possible that this was the fate of Channel 00. We alerted state law enforcement personnel of his disappearance in July, but he has not turned up elsewhere in Arizona as far as we know.

Other than the road crossing area mentioned above, telemetered gila monsters did not appear to use certain habitats in the monument more than others and had fairly large activity ranges. While they were partial to rock outcrops, these are found throughout the park, so we cannot recommend special protection for any area used by the monsters once the emergence period is over. The importance of free water to gila monsters may help explain their presence in the housing area during the active season. As well, the large number of Gambel Quail that frequent the housing area for food and water (provided by the rangers, pers. obs.) likely provide food (eggs).

Photo comparisons have been shown to be a reliable method for documenting recaptures of gila monsters over time, even over 10 years or more. We highly recommend that this

practice be continued, and be adopted by other southwestern parks containing the species monsters as a non-invasive method for monitoring populations over time.

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2005 Progress Report

To date in 2005, we have compiled and entered all data from 2004. We have continued radio tracking the five gila monsters implanted in 2004. All survived the winter and emerged from hibernation in early to late February. This was about a month earlier than expected, and this pattern was also seen in at least two other studies of telemetered gila monsters in southern Arizona (R. Repp, B. Sullivan, and J. Davis, pers. comm.). We collectively hypothesized that the early emergence was due to higher than normal winter rainfall experienced across the state, but could not agree on a causal reason that drove the gila monsters from their hibernation site. Alterative hypotheses included: moving from dens that were flooded or overly damp and cold, facilitation of early spring mating or non-sexual social interactions, and/or taking advantage of abnormally early litters of baby birds or rabbits.

Peak emergence and/or migration activity in 2005 appeared to again be the first two weeks in April, with a peak on April 7-10. During this time we captured five gila monsters. Three were new adult animals, one female and two males, and all were