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Translocation of urban Gila Monsters: a problematic conservation tool

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Abstract

The Gila Monster (*Heloderma suspectum*) is a large, venomous lizard protected throughout its distribution in the southwestern United States and northwestern Mexico. Rapid urban growth in key areas of its range and increased encounters with humans prompted us to investigate translocation as a conservation tool with "nuisance" Gila Monsters. Twenty-five Gila Monsters reported as nuisances by residents in the northeastern Phoenix Metropolitan Area were translocated from 0 to 25,000 m from their point of capture. Subjects ($N = 18$) translocated less than 1000 m returned to their original site of capture within 2–30 days; none of those ($N = 7$) translocated more than 1000 m successfully returned, they exhibited high daily rates of speed, and were deprived the use of familiar refuges. We conclude that small distance translocations within suitable habitats are ineffective in removing Gila Monsters from areas deemed unsuitable. Moreover, individuals moved significantly greater distances are unlikely to remain at a translocation site, and may experience a variety of costs (e.g., predation risk) associated with high rates of movement.

Keywords: Gila Monster; Translocation; Sonoran Desert; Phoenix; Reptilia; *Heloderma suspectum*

1. Introduction

> "With the possible exception of the vampire bat, no other North American animal has been the source of more superstitions, the subject of as many legends, or the object of more exaggerated claims than the Gila Monster. Brown and Carmony (1991)"

Human populations are rapidly increasing in the American Southwest, and interactions with wildlife, especially top-order carnivores, are rising sharply. The likely outcome, especially for larger taxa, will be local extinctions due primarily to habitat loss and to a lesser extent, direct interactions with residents. One response to these threats is translocation (i.e., movement of wild individuals from one part of their range to another) of individuals to protected or intact habitat patches removed from areas of common interaction with humans. Fischer and Lindenmayer (2000) reviewed translocation studies of animals, and concluded that this technique fails to solve human-animal conflicts satisfactorily. Given the widespread use of translocation as a conservation method (see reviews in Fischer and Lindenmayer, 2000; Shine and Koenig, 2001; Nowak et al., 2002), it warrants further scrutiny, especially for unconventional, nongame animals such as reptiles.

Translocation efforts with some species are complicated due to their potential threat to humans, such as a venomous bite (Shine and Koenig, 2001; Nowak et al., 2002). One of the most notorious, large venomous reptiles encountered by residents in the southwestern United States is the Gila Monster (*Heloderma suspectum*), one of two species of helodermatid lizards and closely related to Old World varanids (Pregill et al., 1986; Schwenk, 1988; Bernstein, 1999). Gila Monsters are perhaps perceived as less threatening than other venomous reptiles such as rattlesnakes (*Crotalus* spp.), but they remain misunderstood by the public and experience many of the same conservation issues facing rattlesnakes as a result of urbanization. Translocation of venomous reptiles is widely practiced in metropolitan regions; each year many hundreds of rattlesnakes and

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dozens of Gila Monsters are removed from residences and other locations in the Phoenix and Tucson metropolitan areas of Arizona, USA, and translocated to nearby desert habitats (Hare and McNally, 1997; Nowak et al., 2002; Mike Demlong, pers. comm.). Although recent reviews of results of translocation studies involving reptiles revealed consistently low success rates for snakes (Dodd and Seigel, 1991; Reinert and Rupert, 1999; Plummer and Mills, 2000; Nowak et al., 2002), Gila Monsters remain unstudied.

The secretive habits of Gila Monsters have contributed to a lack of knowledge on the part of biologists, as well as public misunderstanding. In spite of this, the Gila Monster was one of the first venomous reptiles to receive legal protection (Grant, 1952; Brown and Carmony, 1991; Bogert and Martin del Campo, 1993). In response to threats of commercial overcollecting for roadside menageries, zoological supply companies, and related venues, the Arizona Game and Fish Commission provided the initial steps in 1950 to legally protect Gila Monsters in Arizona. Subsequently, other states (Nevada—1969; Utah—1971; New Mexico—1975; California—1980), as well as Mexico, provided similar legal protection to Gila Monsters. Moreover, the Gila Monster is provided international protection under CITES (Convention on International Trade in Endangered Species).

The Gila Monster is chiefly a denizen of the Sonoran Desert, and it ranges from the southwestern United States to northwestern Mexico, primarily in Sonora (Campbell and Lamar, 1989; Brown and Carmony, 1991; Bogert and Martin del Campo, 1993). In the United States, it has large populations in Arizona, and peripheral populations in the Mojave, Great Basin, and Chihuahuan deserts (Campbell and Lamar, 1989; Bogert and Martin del Campo, 1993). Substantial populations likely occur in Sonora (Mexico), but their ecology is largely unstudied. Although two subspecies of Gila Monsters are currently recognized (banded race—*H. s. cinctum*; reticulate race—*H. s. suspectum*), ongoing morphological and mtDNA analyses (Douglas et al., unpubl. data) do not support this simplistic division. With the exception of introduced exotic species (e.g., *Ctenosaura pectinata*; *Iguana iguana*; Conant and Collins, 1998), the Gila Monster is the largest (length and mass) species of lizard naturally occurring in the United States.

Populations of Gila Monsters persist in the vicinity of metropolitan areas experiencing rapid growth, such as Las Vegas, Nevada, USA, and both Phoenix and Tucson, Arizona, USA. Translocation of individual Gila Monsters found in or near houses is currently practiced by various agencies and individuals in the Phoenix and Tucson areas, although the fate of these animals is largely unknown. Translocation of large reptiles such as Gila Monsters is of special concern because they are top-order predators, feeding primarily on birds and mammals (Beck, 1990; Bogert and Martin del Campo, 1993); it is conceivable that their removal and release might have negative ecological impacts (Kjoss and Litvaitis, 2001; Shine and Koenig, 2001). Consequently, with support from the Heritage Program of the Arizona Game and Fish Department, we undertook a study of individuals with surgically implanted radio-transmitters to ascertain the consequences of translocation of "nuisance" Gila Monsters in the northeastern Phoenix Metropolitan Area.

2. Methods

2.1. Subjects

Subjects were obtained through calls from the general public when a "nuisance" Gila Monster was encountered by a resident in the northern Phoenix Metropolitan area and local agency personnel were notified (e.g., Arizona Game and Fish Department). We responded to the call, obtained the Gila Monster at the residence or from the agency personnel that had removed the animal, returned it to the laboratory for processing and surgery, and then released the animal at or near the site, or at some distance from the site if translocation was deemed necessary. Animals were generally released within 72 h of capture. A small number ($N=3$) of animals were retained in the laboratory until radio-transmitters could be obtained for implantation.

Following initial capture, subjects were transported to the Department of Life Sciences, Arizona State University West, where multiple body measurements were obtained, including length and width of head, snout-vent length (SVL), tail length and width, and body mass. Surgical implantation of radio-transmitters was performed within 48 h of capture (generally, procedures followed Beck, 1990). Subjects were anesthetized by placing their head into a clear plexiglass chamber containing air saturated with Isoflurane. A rubber collar around the chamber opening allowed a snug fit around the neck of the subject. They were assumed to be anesthetized when they failed to exhibit reflexes to light squeezing stimulation of their feet using a hemostat. An incision approximately 2 cm long was made longitudinally through the ventral integument and peritoneum just medial to the ribs, and a temperature-sensitive radio-transmitter (Model SI-2T, Holohil Systems Ltd.,164.000–164.999 MHz) was placed in the abdominal cavity. Radio-transmitters implanted in adult subjects had a mass of 11.4 g (always $<10\%$ of body mass); a single juvenile subject (20) was implanted with a smaller radio-transmitter (4.5 g). Radio-transmitters were anchored to a rib with a non-absorbable suture where the base of the antennae entered the transmitter case, and antennae were inserted subcutaneously from the abdominal cavity, extended anteriorly and dorsally, and anchored in the neck region. For subsequent identification, a passive integrated transponder (PIT) tag was also inserted in the abdominal cavity during surgery. The incision through the integument was closed with absorbable sutures and subjects were allowed to recover from anesthesia. Because Gila Monsters cannot be reliably sexed using external characteristics, prior to recovery from anesthesia, individuals were sexed by injection of sterile saline solution 20–30 mm posterior to the cloacal opening to evert a hemipenis. Within 48 h, subjects were released at either the point of capture, or at a translocation site. All subjects were recaptured at least once to monitor changes in mass, and status of surgical incisions.

All subjects were photographed; individuals were easily recognized by matching distinctive pigment patterns on the head and body to the photographs (confirmed by PIT-tag signatures). Subjects recaptured after battery failure (8–21 months) were returned to the laboratory, the radio-transmitter was surgically removed, and the subject released following recovery (Table 1).

2.2. Translocation

Subjects were translocated when the homeowner was anxious about the safety of pets or children, or both, and requested that the Gila Monster not be returned to the immediate vicinity. All subjects were released adjacent to appropriate refuges, either packrat nests or rodent burrows. Other subjects were translocated when the surrounding area was undergoing urban development ($N = 15$). The remaining subjects were moved less than 200 m from their capture site, and considered "non-translocated" ($N = 9$). All of these individuals were observed in the vicinity of their capture site within days of release.

Nine of 15 translocated subjects were released in open habitat away from homes but in the general vicinity (200–7688 m distances) of their original capture sites. The six remaining translocated subjects were released at the primary translocation site, a large (1206 ha) area of State Trust land in the center of the study area. This site was selected because it was the largest area of continuous, relatively undisturbed Sonoran Desert habitat in this region in which surrounding residents reported observing Gila Monsters in 1999 and 2000; many appropriate refuges (packrat nests, burrows) were available. The six subjects translocated to this site were all found in similar Sonoran Desert habitat with similar topography. Despite its acceptable appearance, it was nonetheless surrounded on all sides by paved roadways with significant traffic.

Table 1
Individual ID number (duration of tracking in months), capture date (CAPTURE), termination date (END), translocation DISTANCE (in meters), and apparent OUTCOME (Home = returned to capture site) for all Gila Monsters

ID (months)	CAPTURE	END	DISTANCE	OUTCOME
1 (14.5)	11 Apr 2000	27 Jun 2001	1657	Death
2 (24)	12 Apr 2000	5 Apr 2002	37	Home; tag removed
3 (16.5)	13 Apr 2000	1 Sep 2001	61	Home; tag down
4 (18.5)	13 Apr 2000	31 Oct 2001	136	Home; tag down
5 (17)	19 Apr 2000	27 Sep 2001	0	Home; tag down
6 (16)	24 Apr 2000	24 Aug 2001	240	Home; tag down
7 (16)	26 Apr 2000	1 Sep 2001	360	Home; tag down
8 (11.5)	16 May 2000	30 Apr 2001	937	Home; translocated
8 (1)[a]	30 Apr 2001	15 May 2001	9560	Lost
9 (19)[b]	31 Jul 2000	18 May 2002	169	Home; death
10 (12)[b]	31 Aug 2000	5 Aug 2002	136	Home; tag down
11 (13)	4 Mar 2001	12 Apr 2002	441	Home; tag removed
12 (15)	16 Apr 2001	31 Aug 2002	0	Home: end of study
13(15)	16 Apr 2001	31 Aug 2002	628	Home; end of study
14 (15)	23 Apr 2001	31 Aug 2002	582	Home; end of study
15 (2)	1 May 2001	27 June 2001	68	Home; death
16 (14)	12 May 2001	31 Aug 2002	49	Home; end of study
17 (1)	15 May 2001	1 Jun 2001	18 268	Lost
18 (1)	19 May 2001	1 Jun 2001	22 410	Lost
19 (3)	5 Jun 2001	1 Sep 2001	9845	Lost
20 (9)[b]	4 Jul 2001	15 May 2002	24 700	Tag down
21 (1)	9 Jul 2001	29 Jul 2001	7688	Lost
22 (11)	30 Jul 2001	31 Aug 2002	511	Home; end of study
24 (9)	26 Aug 2001	18 May 2002	270	Home; tag removed
25 (11)	31 Aug 2001	31 Aug 2002	419	Home; end of study

[a] Female 8 was translocated a second time.
[b] Some animals were retained in lab prior to release.

2.2.1. Data acquisition and analysis

Subjects with implanted radio-transmitters were located by an observer on foot using a hand-held antennae and receiver (Telonics TR-1) every 2–3 days from March through October, and every 3–5 days from November through February, 2000–2002. When an individual was located, general notes on behavior (e.g., basking, walking) and location (e.g., in a burrow) were recorded. Universal Transverse Mercator (UTM) coordinates were found for its position using a handheld Global Positioning System (GPS) unit (Garmin 12 XL). UTM coordinates were transferred into ArcView 3.2 Spatial Analysis software (Environmental Systems Research Institute, Inc), and movement patterns were analyzed using the Animal Movement extension (Hooge et al., 1999). Movement patterns were analyzed by year (2000, 2001) for home range area (ha), mean distance moved (m), total distance moved (m), and mean daily speed (m/day). Home range was estimated using 100% minimum convex polygon and kernel 95% contour intervals, as determined by ArcView. For kernel estimates of home range size, smoothing values were determined using least-squares cross-validation (Seaman et al., 1999). Because both measures of home range were highly correlated, only minimum convex polygon values are provided here. Statistical tests were two-tailed with $\propto$ of 0.05.

Table 2
Individual ID number (T = "non-homing translocation"), sex, snout-vent length in mm (SVL), home range in 2000 in hectares (HR 2000), home range in 2001 in hectares (HR 2001), and mean daily speed in meters (mds)

ID	SEX	SVL	HR 2000 (mds)	HR 2001 (mds)
1 (T)	M	250	121.9 (54.8)	95.1 (48.9)
2	F	285	3.5 (7.6)	9.2 (12.1)
3	M	300	44.9 (20.9)	6.5 (13.0)
4	F	240	4.2 (8.3)	28 (11.0)
5	F	265	3.1 (5.6)	4.2 (10.5)
6	F	335	55.9 (46.9)	36.6 (14.8)
7	F	305	6.3 (10.6)	6.7 (14.1)
8	F	308	67.6 (19.1)	7.3 (4.4)
8 (T)[a]	F	308	–	9.8 (34.0)
9	F	340	–	8.8 (8.4)
10	F	290	–	6.8 (7.1)
11	F	305	–	17.8 (8.1)
12	M	320	–	10.1 (6.7)
13	F	230	–	27.5 (16.8)
14	F	255	–	14.4 (9.5)
15	F	289	–	–
16	F	207	–	3.0 (5.2)
17 (T)	F	325	–	– (33.8)
18 (T)	M	258	–	–
19 (T)	M	280	–	190.2 (88.0)
20 (T)	F	180	–	15.4 (10.4)
21 (T)	M	250	–	8.4 (120.5)
22	M	230	–	17.6 (15.8)
24	M	235	–	5.5 (8.7)
25	F	270	–	1.8 (7.8)

[a] Female 8 was translocated a second time on 30 April 2001.

3. Results

Twenty-five Gila Monsters were processed during 2000 and 2001 (Table 1). Two of these were juveniles (20 and 23), and only one (20) was implanted with a radio-transmitter (23 was released untagged). Of the adult subjects, eight were males and 15 were females.

All ($N = 18$) individuals released less than 1000 m from where they were first captured returned to the capture site vicinity in one to thirty days (Table 1). These individuals were thus classified as "non-translocated" for analysis of home range and mean daily speed parameters using movements and refuge use subsequent to successful homing. Because one individual that returned to its capture site in 2000 was translocated a second time in 2001 (female 8), seven individuals were classified as translocated (Table 2). Because of the potential of seasonal effects on home range size and mean daily speed, comparisons were restricted to within years (2000 and 2001), and statistical analysis was only possible with data from 2001 due to sample size restrictions (e.g., only one subject in 2000 was translocated more than 1000 m). Additionally, home ranges could only be calculated for a small number of translocated individuals ($N = 4$) that were relocated on more than five occasions before they were "lost" (see below). There was no obvious homing behavior (e.g., straight-line or circular movements) exhibited by translocated subjects.

From 2000 to 2001 home ranges of non-translocated males ($N = 4$) ranged from 5.5 to 44.9 ha, and non-translocated females ($N = 14$) ranged from 0.25 to 67.6 ha. Many non-translocated subjects consistently used burrows near or under homes and other structures (e.g., utility boxes; Fig. 1). Mean daily speed of non-translocated males ranged from 6.7 to 15.8 m/day, and non-translocated females ranged from 4.4 to 46.9 m/day. Home range ($r = 0.21$, $P = 0.42$, $N = 17$) and mean daily speed ($r = 0.09$, $P = 0.73$, $N = 17$) were not significantly correlated with body size (SVL) in either males or females that were classified as non-translocated in 2001. Given the absence of significant differences between males and females, and that sample size was small, data for the sexes were pooled for comparison of home range and mean daily speed in 2001.

Although home ranges of non-translocated individuals ranged from 1.8 to 36.6 ha in 2001, and those of translocated individuals ranged from 8.4 to 190.2 ha, this difference was not statistically significant (Mann–Whitney $U = 14$, $P = 0.073$, $N = 21$; Table 2). The home ranges of the two translocated adult males followed for at least one month (1 and 19) were especially large (95.1 and 190.2 ha in 2001; Fig. 2a); most translocated individuals were followed for an insufficient period (less than one month) to obtain a meaningful home range

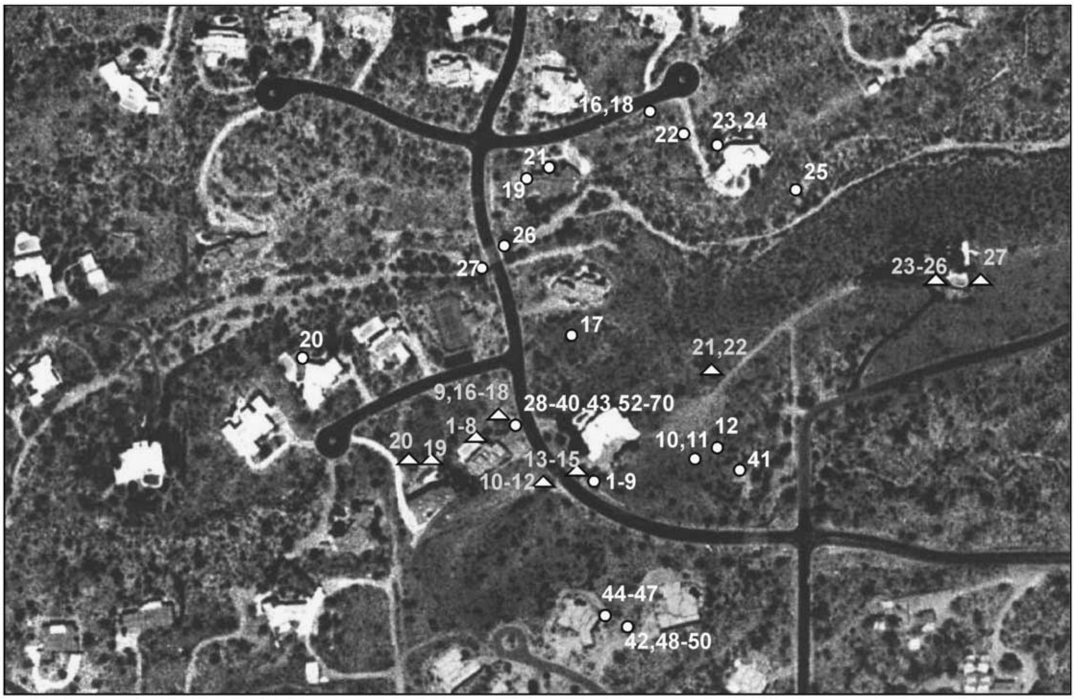

Fig. 1. Aerial photo of the town of Carefree, Maricopa County, Arizona, showing movements and refuge use of two nontranslocated female subjects (9 = circles; 10 = triangles) in 2001. Note refuges used near homes and roadways. Multiple use of the same refuge denoted by numerical sequences (e.g., 52–70 for female 9 represent overwintering site use without apparent movement).

estimate before they were lost. The fate of lost individuals could not be determined, in spite of extensive searches on all surrounding roadways. A small plane was used in an attempt to detect signals from long distance movements (up to 15 km), but proved unsuccessful. In the absence of transmitter battery failure (transmitters were exceptionally reliable initially; none failed within 6 months of implantation), it is reasonable to assume lost individuals died on roadways surrounding the translocation site and the transmitters were destroyed. A single radio-transmitter placed in the body of a Gila Monster found dead was non-functional after only five hits by a passenger car, suggesting they would not last long on a well-used roadway.

Mean daily speed (MDS) of non-translocated individuals ($N = 17$) ranged from 4.4 to 16.8 m/day while that of translocated individuals ($N = 5$) ranged from 10.4 to 120.5 m/day in 2001 (Table 2). Translocated individuals (average MDS = 60.3 m/day) exhibited a significantly higher MDS (Mann–Whitney $U = 8$, $P = 0.007$) than non-translocated individuals (average MDS = 10.24 m/day). For example, female 8 was initially translocated 937 m; she returned to her capture site (home) within 1 month. Over the next 11 months, she exhibited a home range of 67.6 ha, and a MDS of 19.1 m/day. After being removed from a residence on two occasions in spring 2001, at the request of the home owner she was translocated 9560 m to the translocation site. She was lost within 1 month, and during this time exhibited a MDS of 34.0 m/day.

Only two translocated individuals were followed for two seasons. Male 1 was translocated 1,657 m, and exhibited a MDS of 54.8 m/day in 2000 (Fig. 2a), and 48.9 m/day in 2001 post emergence (i.e., March–June). Hence, his MDS in 2001 was not reduced relative to that exhibited in 2000 immediately following translocation. By contrast, female 20 was translocated 24,700 m; immediately after release in late summer, she exhibited a home range of 15.4 ha, and a MDS of 38.68 m/day in the first month following release. During fall and early winter, she moved relatively little, and for all of 2001 her home range was 15.4 ha (MDS = 10.4 m/day). When she emerged from hibernation in March, 2002, she exhibited a home range of only 0.01 ha, and a MDS of only 0.40 m/day. Due to her small size (SVL = 180 mm), it is possible that she had more successfully adjusted to the translocation site than the only other individual that we were able to follow after overwintering at a translocation site. However, she was the only subject under 300 mm SVL that did not gain in mass across seasons, and it is conceivable that she was declining in health as result of her initially high movements subsequent to translocation. Unfortunately, her radio-transmitter failed after 2 months of activity in the spring (March–May, 2002).

During this study three individuals died; two were non-translocated individuals apparently struck by automobiles (9 and 15) and the other was a translocated subject. This male was found dead, apparently killed and eaten by a mammalian predator, 14 months post-release (Sullivan et al., 2002).

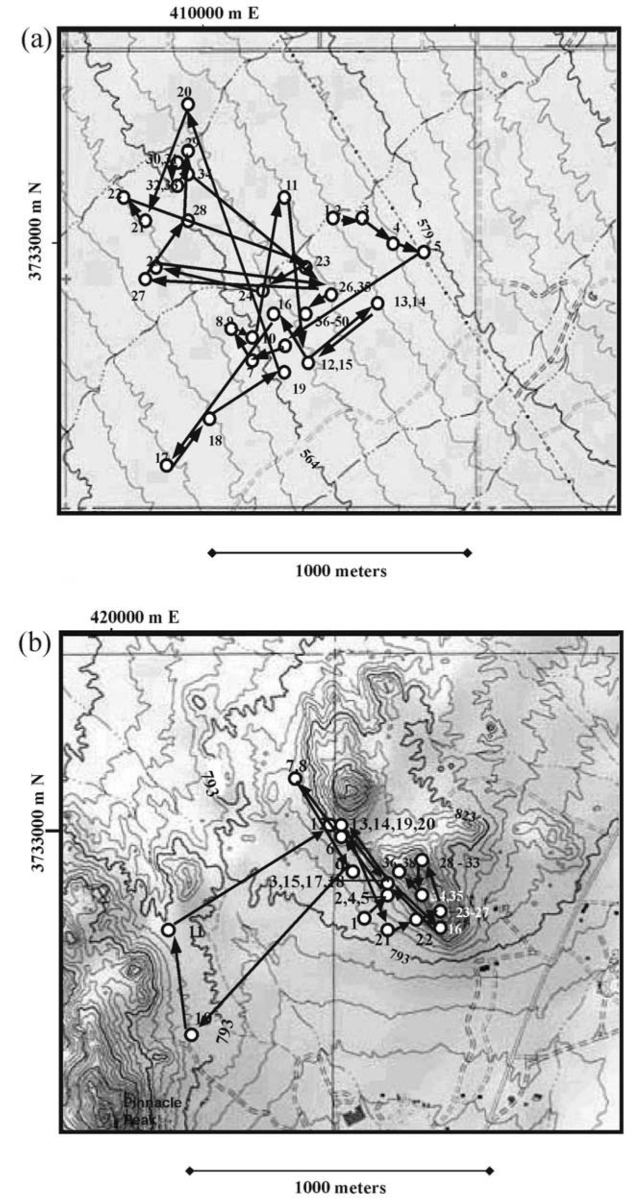

Fig. 2. (a) Movements of translocated male subject (1) at the primary translocation site in 2000; (b) movements of nontranslocated male subject (3) during 2000. Both individuals were followed from late April through December: male 1 used 29 refuges and male 3 used 17 refuges during the 8 month period.

4. Discussion

4.1. Gila Monsters and translocation

Our results indicate that short distance translocations are ineffective as a means of removing Gila Monsters from areas of conflict with home owners. Numerous Gila Monsters that we moved less than 1000 m were encountered (and tolerated) by homeowners, and regularly used refuges near original capture sites following translocation. Clearly, Gila Monsters can successfully return if displaced a short distance; others have documented a direct relationship between translocation distance and return rate in nuisance mammals (e.g., Blanchard and Knight, 1995). If the goal of translocating Gila Monsters is their permanent removal from an area due to human conflict, translocation distance must exceed 1 km.

Gila Monsters translocated more than a kilometer did not return to the original capture site (home), at least in the urbanized desert environment we examined. Unfortunately, all adult subjects that failed to return were lost or died, suggesting that translocated individuals do not readily tolerate a novel environment. Translocated Gila Monsters exhibited higher mean daily movements, almost five times higher than non-translocated individuals. Similarly, Reinert and Rupert (1999) found that translocated timber rattlesnakes moved almost three times as far each day as non-translocated individuals, and Nowak et al. (2002) documented increased movement rates for translocated Western Diamond-backed Rattlesnakes. Increased activity, especially for the typically sedentary Gila Monster (Beck and Lowe, 1994; Beck et al., 1995) might entail significant energetic and thermoregulatory costs, as well as predation risks. The only Gila Monster less than 300 mm SVL that did not increase in mass across seasons was a translocated female (20). The high activity levels of translocated Gila Monsters that we observed may have led to mortality due to predation (e.g., male 1). Reinert and Rupert (1999), Plummer and Mills (2000), and Nowak et al. (2002) documented that translocated snakes in their respective studies differed significantly in mortality rates in relation to release status: translocated individuals had higher mortality. In our study, we suspect that the translocated Gila Monsters that were lost died on roadways surrounding the translocation sites, although we have no direct evidence of this.

Although two non-translocated Gila Monsters with radio-transmitters died as a result of being struck by automobiles, most survived for an extended period, often in close proximity to roadways and homes (Fig. 1). The survivorship of the non-translocated Gila Monsters in the Phoenix urban–desert interface was somewhat surprising given high levels of human activity (e.g., construction, roadways). Parent and Weatherhead (2000) also found that Massasauga were apparently relatively tolerant of human disturbance. Our Gila Monsters were potentially exposed to higher prey densities than might have otherwise been available in the surrounding desert environment. Quail, dove, and cottontail rabbits, are especially abundant in many desert-urban interface environments, even in dry years in which little reproduction occurs among these species in the surrounding desert (B. Sullivan unpubl.).

4.2. Translocation as a conservation tool

We documented significantly increased movement rates for translocated Gila Monsters. Although high activity rates of translocated individuals in novel environments are expected, other effects of translocation require consideration. Many of the non-translocated Gila Monsters that we radio-tracked used the same refuge repeatedly over 12–18 months of observation (Figs. 1 and 2a). Translocation could have negative consequences depending on the degree to which individuals rely on particular refuges for escape from predators, to regulate body temperature or to maintain water balance. Thermoregulatory behavior by ectothermic vertebrates like Gila Monsters might be especially disrupted by a translocation event. Additionally, although there is a general perception that birds and mammals are more likely than reptiles to have structured or relatively complex social systems, and hence be negatively impacted by translocation, it is now appreciated that many reptiles exhibit complex social relationships (e.g., Gardner et al., 2001). Longitudinal study of translocated individuals is necessary to determine the consequences of this conservation technique, but it is clear that the notion that animals can be "rescued" by simply moving them from one area to another is naive and potentially dangerous to the individual and both resident and host populations (Pietsch, 1994; Shine and Koenig, 2001; Seigel and Dodd, 2002).

Translocation can also have significant ecological consequences at the population and community levels. For example, Gila Monsters are one of several top-order predators (young birds and mammals are their primary prey; Beck, 1990) in desert environments. The loss of but a few individuals could negatively impact ecological interactions among remaining species (Kjoss and Litvaitis, 2001; Shine and Koenig, 2001). Translocations also provide opportunity for disease introduction for resident populations (Cunningham, 1996; Shine and Koenig, 2001; Seigel and Dodd, 2002). Furthermore, genetic consequences of translocation requires careful consideration (Stockwell et al., 1996; Whiting, 1997), and concerns have centered on the viability of re-established populations (Stockwell et al., 1996; Madsen et al., 1999). However, most reptile translocations in urbanized desert areas occur over short distances; hence, spread of diseases or parasites is likely minimal (Cunningham, 1996), as are potential negative genetic consequences.

In conclusion, our translocation study of Gila Monsters is important in that it addresses a current urban management problem of a top-order reptilian carnivore that is large, venomous, and protected by law. The negative results of our translocation study place time and monetary constraints on agency personnel concerned with the fate of nuisance animals; there is a clear need for a more satisfactory conservation mechanism. Despite this dilemma, we are optimistic that public education by agencies and scientists working on Gila Monsters can alter negative opinions, and that this species can be portrayed as an extraordinary low risk threat to humans minimizing the need for translocation. Our own interactions with homeowners, for example, demonstrated high interest in the safety and well-being of individual Gila Monsters.

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