An adult male Guatemalan Beaded Lizard, *Heloderma charlesbogerti* (PIT-tag 088.379.117; snout-vent lenght 390 mm; total lenght 656 mm), looks out of a shelter originally made by a medium-sized mammal. An unidentified cricket appears in the upper right portion of the photo; this species of cricket lives in great numbers inside the underground shelters used by *H. charlesbogerti*, and remnants of their exoskeleton have been found in the majority of the fecal samples taken from radio-tracked individuals during the dry season. The Guatemalan Beaded Lizard is an endemic species of venomous lizard with a distribution restricted to remnant patches of seasonally dry tropical forest in eastern Guatemala. Since 2003, local people have spearheaded a strong conservation program for this species and its habitat, with the support of non-governmental and governmental organizations. The photograph was taken at Reserva Natural para la Conservación del Heloderma y el Bosque Seco del Valle del Motagua, El Arenal, Cabañas, Zacapa, Guatemala, elev. 625 m. © Daniel Ariano

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Spatial ecology of the endangered Guatemalan Beaded Lizard *Heloderma charlesbogerti* (Sauria: Helodermatidae), in a tropical dry forest of the Motagua Valley, Guatemala

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Abstract: We studied home range and movement patterns of the Guatemalan Beaded Lizard, *Heloderma charlesbogerti,* over a two-year period in a seasonally dry tropical forest of eastern Guatemala. We captured and permanently identified 32 individuals from March 2006 to March 2008, of which we radio-tracked six. Using the fixed Kernel method, the average home range size (all seasons) was 55.5 ± 73.3 ha. The average home range size was substantially larger during the wet season (94.3 ± 121 ha) than in the dry season (16.6 ± 25 ha). The surface activity was highest from June to October, and activity decreased with a decreasing amount of rainfall. Mammals constructed most of the underground shelters used by the lizards (77.08%). Shelters used during the dry season had been occupied for longer periods than those used during the wet season. The longest occupancy of an underground shelter was 62 days. The results of this study could be used for future conservation management of *H. charlesbogerti* and its habitat.

Key Words: Home range, lizard conservation, radio telemetry, seasonality, shelter use

Resumen: Los ámbitos de hogar y patrones de movimiento del Lagarto Escorpión, *Heloderma charlesbogerti*, fueron estudiados por un periodo de dos años en un bosque tropical estacionalmente seco de Cabañas, Guatemala. Capturamos y marcamos un total de 32 individuos de marzo 2006 a marzo 2008, de los cuales seguimos a seis individuos mediante radiotelemetría. El tamaño del ámbito de hogar promedio para los individuos por el método Kernel fijo fue de 55.5 ± 73.3 ha. La media del tamaño del ámbito de hogar fue sustancialmente más grande para la época lluviosa (94.3 ± 121 ha) que para la época seca (16.6 ± 25 ha). Los meses de mayor actividad fueron entre junio y octubre, mostrando una disminución en la actividad a medida que el patrón de lluvias decrece. La mayoría de los refugios subterráneos usados por estos lagartos fueron madrigueras previamente excavadas por mamíferos (77.08%). Los refugios usados durante la época seca fueron ocupados por periodos más largos que los usados en época lluviosa. El período de ocupación más largo de un refugio subterráneo fue de 62 días. Los resultados de este estudio pueden ser usados para futuros programas de conservación de *H. charlesbogerti* y su hábitat.

Palabras Claves: Ámbito de hogar, conservación de lagartijas, estacionalidad, radiotelemetría, uso de refugios

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INTRODUCTION

The Guatemalan Beaded Lizard, *Heloderma charlesbogerti*, formerly considered a subspecies of *H. horridum* (Campbell and Vannini, 1988), recently was elevated to the rank of full species based on multiple lines of evidence (Reiserer et al., 2013). This species is endemic to the seasonally dry tropical deciduous forests of the valleys of eastern Guatemala, one of the most threatened ecosystems in the world (Domínguez-Vega et al., 2012). Although this habitat is inadequately protected in Guatemala, a private reserve with a long-term conservation program that includes public awareness, education outreach, and scientific research exists, spearheaded by locals dedicated to the protection of 128 ha of the habitat of this species (Ariano-Sánchez et al., 2011). The genus *Heloderma* contains the only extant lizards of the Monstersauria clade, which bear venom-transmitting teeth with a deep venom groove in the rostral carina (Fry et al., 2006; Yi and Norell, 2013). Bites by this lizard are extremely rare, but envenomation is known to produce severe local pain, dizziness, diaphoresis, vomiting, paresthesia, and hypotension (Ariano-Sánchez, 2008). Like other members of its genus, *H. charlesbogerti* is a vertebrate nest specialist predator (Campbell and Vannini, 1988; Ariano-Sánchez, 2003). This species is in critical danger of extinction because of habitat destruction, illegal wildlife trafficking, and the slaughter of individuals by fearful local villagers (Ariano-Sánchez, 2006; Domínguez-Vega et al., 2012). Because of its critical conservation status and permanent threat from illegal wildlife trafficking, this species recently was elevated from Appendix II to Appendix I of CITES (Ariano-Sánchez et al., 2011).

Long-term research and conservation projects involving *H. charlesbogerti* in Guatemala have resulted in the discovery of basic information about its distribution (Ariano-Sánchez, 2003; Ariano-Sánchez and Salazar, 2007; Pons, 2010; Domínguez-Vega et al., 2012), shelter use (Masaya, 2005; Ariano-Sánchez and Salazar, 2012), nest incubation (Ariano-Sánchez and Salazar, 2013), and conservation policies in the country (Zootropic-CONAP-TNC, 2008; CONAP-Zootropic-CECON-TNC, 2011; Zootropic-CONAP, 2013).

Among the other species in the family Helodermatidae, only *H. horridum* has been the focus of substantial research (Beck and Lowe, 1991; Beck and Ramírez-Bautista, 1991; Herrel et al., 1997). This species is known to engage in male-male combat (Beck and Ramírez-Bautista, 1991), and courtship and male-male combat has been reported from September to November (Álvarez del Toro, 1982; Beck and Ramírez-Bautista, 1991). In years where food availability is sufficient, females are known to deposit clutches of 4–8 eggs from October to December; in captivity, incubation periods for *H. horridum* have been reported to range from 154 to 226 days at incubation temperatures from 21°C to 29°C; and clutch sizes have been indicated to range from two to 22 eggs (see Beck, 2005, and references therein).

Using the minimum convex polygon (MCP) method, Beck and Lowe (1991) found the mean home range size (ha) for five *H. horridum* in Jalisco, Mexico, as 21.6 ha, with a substantial overlap of the home ranges among these individuals. These authors reported that during active periods *H. horridum* spends less than one hour per day engaged in surface activity (121 hrs/yr) and moves at a slow pace (0.35 km/h), and that peak activity (17 d/mo) occurs in May, diminishes gradually during the summer, and reaches a low of one day per month in January.

Masaya (2005) and Pons (2010) attempted to determine movement patterns and home range sizes in *H. charlesbogerti*, but their results were inconclusive. Masaya (2005) provided an estimate of movement patterns and home range sizes, but due to technical problems with transmitters the study was conducted over a short period of time and involved fewer than 40 relocations. Pons (2010) experienced similar problems with home range determinations, as his study involved a low number of relocations (48) and a short period of radio-tracking (five mo).

Herein, we present the first long-term study on the spatial ecology of *H charlesbogerti*. The purpose of this study is to determine the home range size of this species by season, determine its annual activity patterns, and present behavioral observations, all in an effort to contribute to the conservation of this species.

MATERIALS AND METHODS

Description of Study Site

Cabañas, Zacapa (14°53'N, 89°47'W) is located in the Motagua Valley of eastern Guatemala. The average annual rainfall (815 mm), temperature (26.9°C), relative humidity (71%), and evapotranspiration (1,798.8 mm) in this region for the years 1990–2006 are typical of seasonally dry tropical forests (CONAP-Zootropic-CECON-TNC, 2011). Rainfall in this area is seasonal, with a wet season that lasts five months, from June to October, and a dry season seven months, from November to May (Nájera, 2006). The landscape of the study area is composed of patches of seasonally dry tropical forest and tropical thorn scrub, within a matrix of cornfields planted along the steep slopes (Fig. 1).

Fig. 1. Seasonally dry tropical forest habitat of *Heloderma charlesbogerti* during the wet season at Cabañas, Zacapa, Guatemala.

The vegetation in forest patches includes such distinctive dry forest species as *Plumeria rubra* (Apocynaceae); *Bursera simaruba* (Burseraceae); *Nopalea guatemalensis*, *Opuntia decumbens*, *Pilosocereus leucocephalus*, *Stenocereus pruinosus*, *Stenocereus eichlami* (Cactaceae); *Acacia picachensis*, *Leucaena collinsii*, *Lysiloma divaricatum*, *Mimosa platycarpa* (Mimosaceae); *Swietenia humilis* (Meliaceae); *Ximenia americana* (Olacaceae); *Bonellia macrocarpa* (Theophrastaceae); and *Karwinskia calderonii* (Rhamnaceae). According to their importance value index, the dominant species in the region are the following: Roble (*Bucida macrostachya*, Combretaceae), Quebracho (*Lysiloma divaricatum*, Mimosaceae), Yaje (*Leucaena collinsii*, Mimosaceae), Campón (*Gyrocarpus americanus*, Hernandiaceae), Tuno de Órgano (*Stenocereus pruinosus*, Cactaceae), and Fruta de Cabro (*Karwinskia calderonii*, Rhamnaceae). The elevation in this area ranges from 310 to 950 m (asl). Most of the topography is undulating, with steep slopes clustered in the range of 40–70%.

Field Methods

We captured individuals with the help of local villagers, by conducting extensive searches in potential underground shelters or by walking along the forest or cornfields within the study site. We determined their sex through manual eversion of the hemipenes, and also by comparing the snout–vent length (SVL) and tail length (T) ratios (Gienger and Beck, 2007). We took measurements of the total length (TL), snout–vent length (SVL), tail length (T), and the diameter of head at eye level (H) for each individual, and also marked them with PIT-tags (AVID microchips, Los Angeles, California, United States) inserted at the level of the right forelimb. We fitted radio transmitters (CHP-5P by Telonics, Mesa, Arizona, United States) to six lizards and tracked them using an ATS FieldMaster FM100 Receptor. We surgically sutured a transmitter to each lizard, within the 2nd and 3rd tail ring (ca. 20 mm posterior to the vent), and to improve the security of the transmitters wrapped them with duct tape (Truper, United States), carefully so as not to obstruct the vent.

We collected data three days after releasing the lizards (Weatherhead and Anderka, 1984; Beck and Lowe, 1991). We located and tracked them using the homing-in method of White and Garrot (1990), and radio-tracked individuals twice a week from March 2006 to March 2008. When a shelter was located, we marked it with a plastic tag and georeferenced it using an Etrix GARMIN GPS (UTM coordinates, NAD 27 zone 16 datum). Our behavioral observation method was *ad libitum* focal sampling (Vaz-Ferreira, 1984).

Home Range Analysis

We used the Animal Movement extension 2.0 (Hooge and Eichelaub, 2000) in Arcview 3.2 (ESRI, 2000) to estimate home range size. We calculated home range size using fixed 90% Kernel method with least-squares cross-validation to determine the smoothing factor (Worton, 1989, 1995; Seaman and Powell, 1996; Millspaugh and Marzluff, 2001). We took the density contour calculations at 50% for the core centers (Samuel et al., 1985). This method is relatively unaffected by small samples and time autocorrelation (Rose, 1982; Legendre, 1993; DeSolla et al., 1999; Millspaugh and Marzluff, 2001). This method also produced similar estimates of home range size compared to the traditional minimum convex polygon in other reptiles (Mitrovich et al., 2009). The home range estimates by season (dry/wet) were made with a minimum of 20 relocations for each individual. Additionally, we characterized the forest cover within the home range areas.

To determine the distances moved between locations, we used the Animal Movement Extension 2.0 (Hooge and Eichelaub, 2000) developed for Arcview 3.2 (ESRI, 2000). We measured movements as straight-line distances between relocations, and provide means as ± 1 SD.

RESULTS

We captured 32 *Heloderma charlesbogerti* (14 females, 16 males, two juveniles) from March 2006 to March 2008. The mean SVL for males was 360.1 ± 22.5 mm (range = 266–457 mm), and for females 326.6 ± 66.1 mm (range = 234–410 mm). Of these, we radio-tracked six individuals (three males, two females, one juvenile) from March 2006 to March 2008, and made 302 relocations (Table 1).

Table 1. Relocations and home range of six individuals of *Heloderma charlesbogerti* radio-tracked from March 2006 to March 2008 at Cabañas, Zacapa, Guatemala.

PIT-tag Number	Sex	SVL (mm)	Total Number of Relocations	Rainy Season Home Range (ha)	Dry Season Home Range (ha)	Home Range (ha)
088.379.117	Male	390	55	329.1	67.9	198.5
094.333.040	Male	335	50	115.7	11.6	63.6
094.357.347	Juvenile	210	44	3.6	1.1	2.3
094.513.073	Male	285	53	67.4	5.5	36.4
094.519.273	Female	384	58	23.9	8.8	16.4
094.581.078	Female	380	42	25.9	5.1	15.5
Mean				**94.3** ± 121	**16.6** ± 25	**55.5** ± 73

Home Range

Using the fixed Kernel method, the average home range for the six individuals was 55.5 ± 73.3 ha (Table 1). Home range area size data showed strong variation ranging from 2.3 ha (juvenile PIT-tag 094.357.347) to 198.5 ha (male PIT-tag 088.379.117).

We found home range size differences between the dry and wet seasons (Fig. 2). The mean home range size during the wet season was of 94.3 ± 121 ha, five times greater than the average mean home range size for the dry season (16.6 ± 25 ha). A substantial overlap in the home range size of these individuals occurred during the wet season. The dry season home range was characterized by dense forest composed of *Bucida macrostachya* and *Lysiloma divaricatum* in steep slopes covered by the terrestrial bromeliad *Hechtia guatemalensis*.

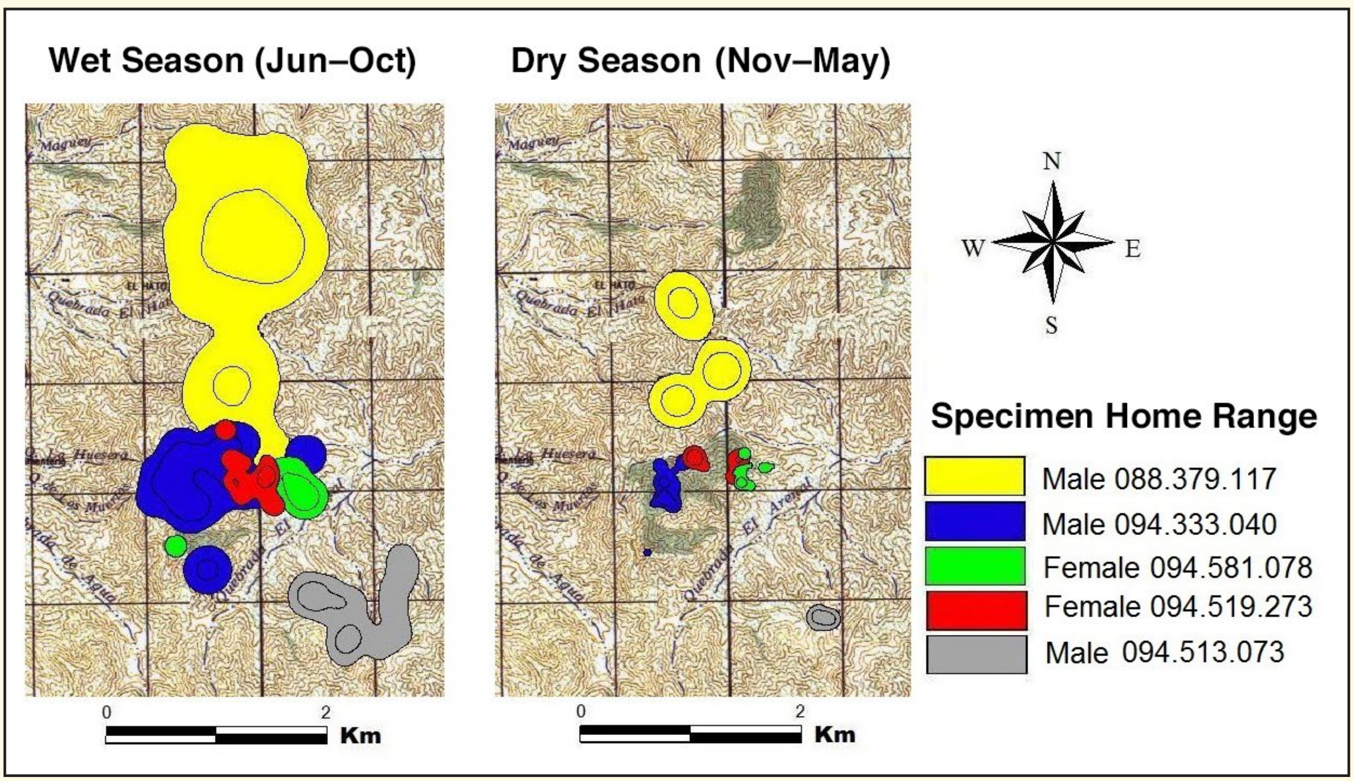

Fig. 2. Home range by season (wet/dry) of five *Heloderma charlesbogerti* radio-tracked from March 2006 to March 2008 at Cabañas, Zacapa, Guatemala. The home range of the juvenile 094.357.347 (Table 1) is not shown because of its small size, compared to the scale of the map.

Activity Patterns

We observed that the activity of *H. charlesbogerti* increased significantly during the wet season (Figs. 2, 3). The period of major activity extended from late April to late October. Activity peaked in August, and decreased slowly through October and November (Fig. 3). The highest period of activity was from June to October, and it decreased as rainfall began to decline. During the driest part of the dry season, December to March, individuals showed a reduction in surface activity. We detected a peak of activity in April, just before the onset of the wet season. According to these data, *H. charlesbogerti* undergoes a period of aestivation during the dry season, from early December to March, during which its activity decreases significantly.

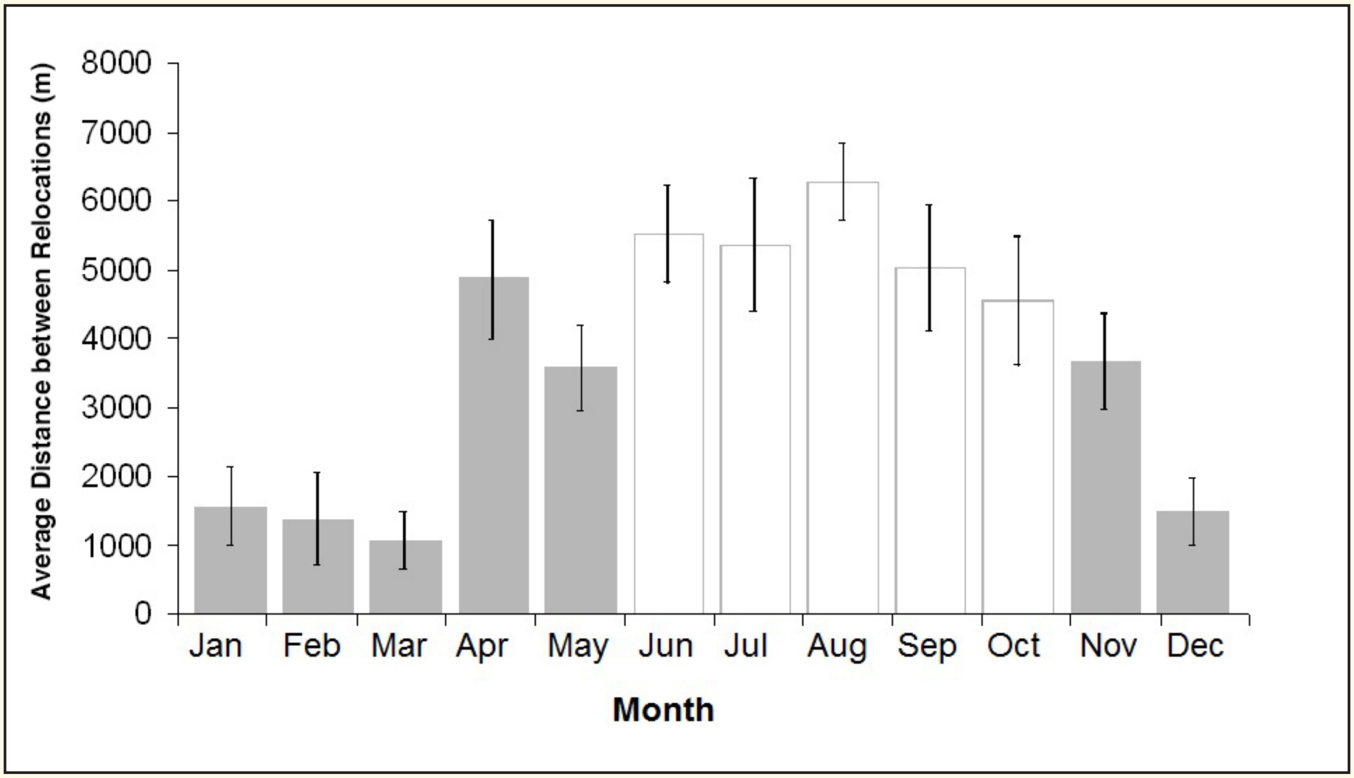

Fig. 3. Patterns of activity estimated as monthly average distance traveled between relocations from six *H. charlesbogerti* radio-tracked from March 2006 to March 2008 at El Arenal, Zacapa, Guatemala. Gray columns correspond to the dry season and white columns to the wet season.

Shelter Use and Occupancy Periods

Of the 238 shelters used by *H. charlesbogerti* in this study, 1.66% (n = 4) consisted of temporary bodies of water in tree cavities (phytotelmata) above the ground, 7.01% (n = 19) were nest cavities in cliffs made by birds of the lineage Momotidae, 12.5% (n = 30) were abandoned burrows possibly excavated by spiny-tailed iguanas (*Ctenosaura similis*), and 77.08% (n = 185) were abandoned burrows excavated by small and medium sized mammals. Based on the burrow size and hair samples found within the burrows, these possibly were made by skunks (*Spilogale angustifrons*, *Conepatus leuconotus*, and *Mephitis macroura*) and Nine-banded Armadillos (*Dasypus novemcinctus*), which are abundant at the study site.

The occupancy periods of the shelters used during the dry season (November to May) were substantially longer than those in the wet season (June to October). The longest occupancy period of an underground shelter was 62 days (female PIT-tag 094.519.273). These results contrast the occupancy periods observed during the rainy season, where the maximum period of occupancy was seven days (male PIT-tag 088.379.117).

Reproduction

We observed adult males of *H. charlesbogerti* enter into the home range of adult females during September and October. In September 2006, we saw male PIT-tag 088.379.117 and female PIT-tag 094.519.273 crawling together and later sharing an underground shelter. In the same month, male PIT- tag 094.333.040 used three shelters that female PIT-tag 094.519.273 previously had used during the reproductive season. We did not observe any male-male combat during the study period, although it has been observed in this species (G. Schuett, pers. comm.).

Female PIT-tag 094.519.273 was gravid at the beginning of November 2006, as we detected egg masses in her abdomen by direct ventral palpation. During the second week of November 2006, this female entered an underground burrow originally made by a medium sized mammal, and remained there for 12 days at a depth of ca. 2.50 m. On 25 November 2006 the female emerged notably thinner, and a tactile exam revealed that she contained no eggs. On 21 April 2007 (149 days later), tracks at the entrance of the burrow indicated that newborns had left this underground retreat. Internal inspection of the burrow revealed four hatched eggshells. The nest described above was monitored with EL-USB-2 preprogrammed Lascar® data loggers. The average incubation temperature was 26.4 ± 1.1°C, the average relative humidity was 82.2 ± 9.8%, and the average dew point temperature was 23.0 ± 2.4°C. The temperature inside the nest ranged from 23 to 29°C; the relative humidity ranged from 58.5 to 95%, with the lowest percentages occurring near the end of the incubation period; and the dew point temperature ranged from 16.8 to 27.6°C.

Additional Behavioral Observations

On several occasions, we observed *H. charlesbogerti* climbing in trees. The maximum height at which we saw an individual in a tree (*Bucida macrostachya*) was ca. 15 m above the ground (male PIT-tag 088.379.117). The use of temporal water bodies that form within cavities of tree trunks (phytotelmata) at the beginning of the wet season also is evidence of the climbing abilities of these animals. We made all of these observations at the beginning of the rainy season, in July and August.

DISCUSSION

We subscribe to the view that home range size is the spatial extent or outside boundary of an animal's movements during the course of its daily activities (Burt, 1943; Perry and Garland, 2002). The core centers of a home range are portions with high use intensity that in the space are related to a limiting resource, such as shelter, food, or water (Samuel et al., 1985; Samuel and Green, 1988). Home range usually is associated with one or more resources, including food, shelter, mates, thermoregulation sites, and escape routes (Vitt and Caldwell, 2009). We observed that the dry season home ranges among individuals show only a minimal overlap, compared with those of the wet season (Fig. 2). The dry season home ranges contain shelters in dense forest cover in steep slopes covered by the terrestrial bromeliad *Hechtia guatemalensis*, which at the study site usually are less exposed to sun and wind. This habitat and its shelters apparently provide a less extreme environment that allows *Heloderma charlesbogerti* to survive the five-month aestivation period, and function as limiting resources for the species. Low overlap in dry season home range could help decrease competition for such limited resources as dry season shelters, which can result in the absence of the ritual fights reported in the wild by male lizards of other species in this genus (Beck and Ramírez-Bautista, 1991).

In reptiles, seasonality in resource availability has been shown to affect such ecological aspects as density, home range, shelter selection, and movement patterns (Fleming and Hooker, 1975; Ruby 1978; Beck, 1990; Beck and Lowe, 1991; Beck and Jennings, 2003; Beaudry et al., 2009; Carriere et al., 2009; McCaster and Downs, 2009). The drastic decrease in home range size (Fig. 2) and surface activity (Fig. 3) during the dry season likely serves to conserve energy and water reserves during a time of food shortage and low humidity conditions in the Motagua Valley. Higher rates of transcutaneous water loss and lower tolerance of dehydration are present in beaded lizards than in the Gila Monster (*H. suspectum*), perhaps because beaded lizards live in more humid environments (D. DeNardo, pers. comm.). Accordingly, we interpret the decreased surface activity during the dry season as a behavioral tactic to avoid severe dehydration.

The overall activity patterns for *H. charlesbogerti* (Fig. 3) are similar to those described for *H. horridum* in Chamela, Mexico (Beck and Lowe, 1991), as they show higher surface activity during the wet season. The beginning of this season coincides with the hatching time for many bird species from throughout the Motagua Valley

(Howell and Webb, 2000). This activity pattern, combined with the ability of *H. charlesbogerti* to climb high in trees, provides this species with increased opportunities to locate bird eggs and nestlings. Apart from this, a close examination of the activity patterns for *H. charlesbogerti* shows an interesting difference from those described for *H. horridum* (Beck and Lowe, 1991). This difference consists of a dry season activity peak detected in April (Fig. 3), which in this region coincides with the egg-laying season of the Motagua Valley Spiny-tailed Iguana, *Ctenosaura palearis* (Cotí and Ariano, 2008).

The eggs from *C. palearis* appear to be an important part of the diet of *H. charlesbogerti*, especially at the end of the aestivation period. Fecal material obtained from males (PIT-tag 094.523.073 and PIT- tag 094.333.040) in April 2007 contained only *C. palearis* eggshells. These eggs represented an opportunity for feeding and recovering from the dry season aestivation period before the beginning of the rainy season, when birds began to lay their eggs. The conservation of the endemic and endangered *C. palearis* is important to ensure the conservation of *H. charlesbogerti* in the Motagua Valley.

Fecal samples taken from individuals during the dry season contained only insect remains, suggesting that *H. charlesbogerti* actively ingests insects that live inside their underground shelters as a feeding resource available during the driest part of the year. The orthopteran remains found in the samples are those of an unidentified cricket that lives in great numbers inside the underground shelters used by *H. charlesbogerti*.

Previous work with *H. horridum* in Jalisco, Mexico, indicates the existence of ritual fights among males in nature, consisting of the formation of a body arch by the two opponents (Beck and Ramírez-Bautista, 1991), which also has been documented in captives (G. Schuett, pers. comm.). The topography of the study site, characterized by steep slopes ranging from 40 to 70% (Fig. 1), may be a factor that affects the apparent absence of ritual fights in the wild in this area, because the formation of a body arch might cause the opponents to roll down a slope.

The reproductive season of *H. charlesbogerti* is in September and October, and according to our analysis of movement patterns and behavior oviposition occurs in mid November. Juveniles hatch in May and June, just before the beginning of the wet season. This synchronization with the wet season could help ensure that juveniles have a better opportunity to obtain prey relative to their size.

The use of flooded tree cavities (phytotelmata) as shelters during the beginning of the rainy season might explain an established behavior of captive helodermatid lizards. In captivity, these lizards usually spend considerable time submerged in their water dishes, sometimes for more than one hour (D. Ariano, pers. observ.), or considerably longer (J. Campbell, pers. comm.). We suggest that the behavior observed in captivity mimics their behavior in nature, where they remain submerged in water at the beginning of the wet season.

The conservation efforts dedicated to identifying and protecting adequate habitats for vulnerable species can be guided by the localization of core centers within the home range of species. Knowing the characteristics of the home range can provide better tools for handling species that live in arid climates, which are more susceptible to habitat loss or damage by human activities (Beck and Lowe, 1991; Beck and Jennings, 2003). Identifying the home range that contains limiting resources for the species can optimize the management of fragmented landscapes, such as the seasonally dry forests of the Motagua Valley in eastern Guatemala. Accordingly, the limiting resources for this species can be protected. Moreover, the home range data shown here were the main support for a land purchase of 128 ha to establish a natural private reserve that contains part of the home range of four radio-tracked individuals (Ariano-Sánchez et al., 2011).

In the face of limited funding, knowledge, and time for action, conservation efforts often rely on shortcuts for the maintenance of biodiversity. *Heloderma charlesbogerti* is dependent on breeding populations of vertebrates (mammals, reptiles, and birds) in order to obtain prey (young mammals and birds, bird and reptilian eggs). The species also requires forest cover in good condition that can provide enough refuges during the dry season, as well as the presence of adequate populations of burrowing medium sized mammals and iguanas to build underground burrows that can be used by *H. charlesbogerti* as shelters. These characteristics make *H. charlesbogerti* an excellent candidate as an umbrella species to protect seasonally dry tropical forest biodiversity within Guatemala. An umbrella species is one whose conservation provides a protective umbrella for numerous co-occurring species (Fleishman et al., 2000). By directing management efforts toward the requirements of the most exigent species, one is likely to address the requirements of many cohabitants that use the same habitat (Roberge and Angelstam, 2004). Finally, in view of the ecology of *H. charlesbogerti*, this taxon might be considered an important indicator species for habitat quality in the dry forest remnants of the Motagua Valley in Guatemala.

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Daniel Ariano-Sánchez is a conservation biologist and Professor of Ecology at the Universidad del Valle in Guatemala. He is also the Director of the Natural Reserve for the Conservation of *Heloderma charlesbogerti* in Guatemala, with the local NGO Zootropic. His principal interests are the ecology and conservation of the dry forest and cloud forest herpetofaunas of Guatemala, with a focus on *Heloderma*, *Ctenosaura*, *Abronia*, *Plectrohyla*, and *Bothriechis*. Daniel has autored or co-authored over 30 peer-reviewed papers and notes on herpetological topics, along with more than 100 publications directed at increasing public awareness on reptile and amphibian conservation. In 2008, he won the Young Scientist Award from The World Academy of Sciences. He also has been involved in the development of conservation policies for the Mesoamerican herpetofauna at national and international levels, such as the National Strategies for *Heloderma* and *Ctenosaura* Conservation in Guatemala, the transfer of *H. charlesbogerti* from the Appendix II to Appendix I of CITES, and the inclusion of the *Ctenosaura palearis* clade (*C. bakeri*, *C. melanosterna*, *C. oedirhina*, and *C. palearis*) in Appendix II of CITES.

Gilberto Salazar is a devoted conservationist and forest guard at the Natural Reserve for the Conservation of *Heloderma charlesbogerti* in Guatemala, with the local NGO Zootropic. Gilberto is one of the Guatemalan Beaded Lizard's most active champions. His principal interest is to increase public awareness on the conservation of dry forest and its associated species, especially *H. charlesbogerti* and *Ctenosaura palearis* in the Motagua Valley in Guatemala. To date his work on habitat restoration, research, and local outreach have made a collective impact on more than 35,000 local villagers, in a culture that once feared and maligned the venomous reptiles almost to extinction. In 2010, Gilberto won the Disney Conservation Hero award for his efforts in promoting the conservation of the Guatemalan Beaded Lizard, the first Guatemalan to receive this award. Along with Daniel Ariano-Sánchez, he has been promoting the study and conservation of *H. charlesbogerti* for over 12 years.