IRCF

REPTILES & AMPHIBIANS

CONSERVATION AND NATURAL HISTORY

VOL 18 NUM 3 JUN 2011

MICHAEL FOURAKER

A 1952 Chevrolet in Habana Vieja (Old Havana). Vintage American-made cars were an attraction for visitors attending the 14th annual Iguana Specialist Group (ISG) meeting in Cuba in November 2010 (see the travelogue on p. 168).

ELI GREENBAUM

Chrysobatrachus cupreonitens, described in 1951, was "rediscovered" this year. It has a unique skeleton, ecology, and mating behavior. It is endemic to the highest elevations (above 2,800 m) of the Itombwe Plateau, Democratic Republic of the Congo, where it lives in flooded grasslands (see Newsbrief on p. 190).

ADAM L. CRANE

Ozark Zigzag Salamanders (*Plethodon angusticlavius*) with chytridiomycosis demonstrated obvious morphological changes and behavioral anomalies. Infected individuals sloughed large patches of skin and elevated parts of their bodies off the substrate until they had difficulty walking (see article on p. 138).

Front Cover: Thomas Wiewandt

The critically endangered Zapata Toad (*Peltophryne florentinoi*) occurs only on the Zapata Peninsula, where predicted marine intrusions will likely inundate much of the species' habitat. See the travelogue on p. 168.

Back Cover: Roy Toft

San Salvador Rock Iguanas (*Cyclura rileyi rileyi*) on Green Cay have become accustomed to tourists and congregate near the boat landing hoping to be fed. See article on p. 154.

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THOMAS WIEWANDT

Populations of the critically endangered Cuban Crocodile (*Crocodylus rhombifer*) have declined dramatically. The species is no longer found in most of its historic range and is currently restricted to two relatively small areas in Cuba. Principal threats include declines in habitat quality, illicit exploitation, and widespread hybridization with American Crocodiles (*C. acutus*).

ROBERT W. HENDERSON

Although the snake may be indistinct, the reflected eyeshine clearly announces the presence of a treeboa.

Going Out on a Limb: An Estimate of the Number of Treeboas (*Corallus grenadensis*) on Grenada

Robert W. Henderson

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During a recent visit to Grenada and a meeting with personnel of the island's Division of Forestry, I was asked how many treeboas (*Corallus grenadensis*) occur on the island. I was surprised at the question, and I responded that I had no idea. Back in my museum office, however, I started to think about the question and wondered if I could, indeed, calculate a very rough estimate, knowing full well that it was an exercise fraught with many pitfalls.

Eight thousand years ago, about 63% of Grenada was covered in forest; in 2000, forests covered only an estimated 15% of the island (World Resources Institute 2003). Today, Grenada (311 km^2) is a patchwork of wooded and open areas dominated by cropland, crop/natural vegetation, shrublands, savanna, and grasslands (World Resources Institute 2003, Helmer et al. 2008), in large part due to its colonial history and the extensive estates that once dominated the island's landscape. For example, in 1772, 125 of 334 estates on Grenada were devoted to sugar cultivation (Brizan 1984), and those 125 estates extended over nearly 13,000 ha, accounting for 42% of Grenada's surface area. In 1824, at least 342 estates were still in operation and agricultural practices had effectively parceled the landscape into many isolated patches of woodland (Brizan 1984) separated by large expanses of treeless cropland. Although many fewer estates are active now, agricultural practices of 150–250 years ago might, today, impact the ecology of an arboreal snake (Henderson 2002, 2008).

ROBERT W. HENDERSON

Edge habitat at Westerhall in February 2006.

ROBERT W. HENDERSON

Edges along paved roads with vehicle and pedestrian traffic and hotels still harbor treeboas.

Taking into account all the habitat transitions, enclaves of human activity, potential *Corallus grenadensis* habitat, and other factors that can impact animal distributions would be next to impossible, as would calculating population densities of treeboas for all the many possible variables of habitat that occur on the island. For these reasons, any attempt to determine the number of individual *C. grenadensis* on Grenada could go horribly wrong.

Methods

As nocturnally active *Corallus grenadensis* is virtually restricted to edge situations in a variety of habitats, I used the lengths of roads (primary, secondary, and 4-wheel drive roads) and rivers to ascertain an approximate value for a portion of edge habitat on the island. Based on hundreds of hours of searching for treeboas, I used the value of 1.0 m on either side of a road or along the banks of a river as to how far active treeboas penetrated the "edge" off a road or riverbank; although by day, the diurnally quiescent boas will rest on arboreal perches deeper than 1.0 m into wooded areas. Therefore, the length of road or river x 2.0 provided the area in which treeboas would occur along a stretch of edge habitat. That value was then converted to hectares. For example, 100,000 m of road x 2.0 m = 200,000 m^2 = 20 ha. Once calculated for each type of road and for rivers, I subtracted 9% of the

CRAIG S. BERG

A Grenada Bank Treeboa (*Corallus grenadensis*) with a noticeable bulge in its stomach. It was encountered along a dirt road at Les Avocats (St. David Parish).

value as approximately 9% of Grenada's surface area occurs at elevations higher than 500 m above sea level, and treeboas are rare or absent at those elevations.

Edge habitat for *C. grenadensis*, however, is not restricted to roads and rivers. Edge can occupy various levels in a given habitat (e.g., Henderson 2002: Fig. 3.1), and it can occur anywhere where tree crowns are contiguous and far removed from a road or a river (e.g., bordering an agricultural field). Using the Rule and Path functions on Google Earth®, I measured the amount of edge habitat in 25 randomly selected plots below 500 m. Those plots had a mean area of 1.88 ± 0.19 km^2 (range = 0.32–3.84 km^2). I divided the total area of Grenada (minus the 9% above 500 m) by the total area of the 25 plots (47.09 km^2). That figure was multiplied by the total amount of edge habitat calculated from the 25 plots (mean = 2.80 ± 0.34 km; range = 0.0–6.57 km; total = 70.18 km) to provide the amount of miscellaneous edge habitat below 500 m on the island (= 422 km). Not being along a road or river, there is only one side of edge, so the amount of edge resulted in an additional 42 ha of miscellaneous treeboa habitat.

Based on extensive ground-level experience at various sites in Grenada, I know Google Earth did not provide the necessary resolution to measure all woodland edge situations. However, since not all edge habitats are suitable treeboa habitat (see below), I have not attempted to factor in this "unaccounted" edge.

I determined densities of *C. grenadensis* at several localities between 1992 and 1998 by visual encounter surveys wherein snakes were counted along transects of known length and over periods of weeks at different times of the year. Mean counts were extrapolated to number of boas/hectare. This simplistic method is likely more useful with species of *Corallus* than with any other nocturnally active snake species in the world. Due to their arboreality and the reflection from their eyes, *C. grenadensis* is easily visible from 50 m or more at night. Nevertheless, an active boa whose head is shielded by foliage may well go unobserved. The sites at which density estimates were made would be considered either secondary roads (e.g., Beausejour Estate) or 4-wheel-drive roads (e.g., Mt. Hartman Bay, Westerhall Estate, Pearls), where the habitat was either mixed orchard trees and native vegetation, or mangrove-*Acacia* ecotone, and treeboa densities ranged from 4/ha to 69/ha.

My rationale for densities attributed to road, river, or miscellaneous edge is as follows: For primary roads, which often run through human population centers and generally are suboptimal treeboa habitat, I used the lowest density I calculated at any site, which was 4/ha. For secondary roads, I used the lowest density I recorded along the road at Beausejour Estate, a value of 19/ha. Along 4-wheel drive roads, I used the average of low-end values for densities recorded at Pearls and Westerhall estates, yielding an estimate of 36/ha. For rivers, I used the average of densities calculated along the road above the Beausejour River and along the river itself, giving a value of 23/ha. Finally, for miscellaneous edge habitat (no roads or rivers), I used the high value of 19/ha for the trail at Mt. Hartman Bay, a site that I considered borderline good treeboa habitat. Henderson (2002) provided detailed information and photographs of the sites.

The methods used here have shortcomings, some obvious, others more subtle. For example, according to Landsat imagery, Grenada has 308 ha of high-medium density urban or built-up land (Helmer et al. 2008). Some of this land-use category is all concrete and commercial buildings and certainly devoid of trees and treeboas, but some of it does support trees with contiguous crown habitat, and treeboas do occur in some very unlikely situations. Likewise, 2,343 ha were designated pasture, hay, or inactive agriculture (e.g., abandoned sugarcane) (Helmer et al. 2008). Although one thinks of sugarcane as treeless, I have encountered *C. grenadensis* in trees bordering active and abandoned sugarcane fields. Therefore, again, I have made no attempt to further refine the amount of land that may or may not harbor treeboas.

Table 1 provides road, river, and miscellaneous habitat lengths, number of associated hectares, and treeboa densities for each.

Results

My calculations resulted in a total of 360 ha of potential *Corallus grenadensis* habitat. Given the various densities used to calculate this figure (Table 1), I estimate the total population of *C. grenadensis* on Grenada to be approximately 7,000–8,000 individuals.

Discussion

I have suggested (most recently in Henderson 2008) that humans, through much of their shared history with *Corallus grenadensis*, have contributed to an increase in treeboa numbers by increasing the amount of edge habitat owing to the distribution of estates and agricultural practices. I also have suggested that numbers of treeboas may be on the decline since a likely peak in the late 19th century (Henderson 2008); certainly the past 10–15 years have seen declines at some sites (e.g., Henderson et al. 2009), possibly

Table. Amount of potential habitat, population densities, and number of *Corallus grenadensis* on Grenada. Road and river lengths were provided by the Land Use Division (Ministry of Agriculture) on Grenada and based on a 1986 map. Miscellaneous habitat was calculated based on measurements off Google Earth.

Edge Type	Length (km)	No. of Hectares	Treeboa Density	No. of Treeboas
Primary Roads	275	55	4/ha	220
Secondary Roads	269	54	19/ha	1,026
4-wheel Drive Roads	232	46	36/ha	1,656
Rivers	816	163	23/ha	3,749
Miscellaneous	422	42	19/ha	798
TOTAL				**7,449**

due to a decrease in land devoted to agriculture and an increase in urban or "built-up" land (Helmer et al. 2008), an associated loss of edge habitat, and changes in the composition and structure of forested situations. Abiotic factors, too, have the potential to impact the ecology of treeboas in Grenada (Henderson 2002, Sun et al. 2001), but here I will focus on two variables I believe most likely to influence *C. grenadensis* distribution and numbers: Food and habitat.

Corallus grenadensis preys predominantly on anoles (*Anolis aeneus* and *A. richardii*) and introduced rodents (*Mus musculus* and *Rattus rattus*). Fieldwork by Harris et al. (2004) at two sites for which I determined densities of *C. grenadensis* (Mt. Hartman and Westerhall), calculated population densities of 830–12,250/ha for the two anole species combined. Although density estimates of the rodent species are lacking, many hundreds of hours of nocturnal fieldwork on Grenada suggest that they, like anoline prey, are abundant and widespread.

Recent (2010–11) fieldwork at Westerhall emphasized the importance of the composition and structure of plant communities within treeboa habitat. Seventeen years had passed since a previous project at Westerhall addressed habitat use (Henderson and Winstel 1995) and calculated treeboa densities (Henderson 2002). Hurricane Ivan hit Grenada in 2004, and many wooded areas were devastated, including that at Westerhall (Henderson and Berg 2005). Trees were leveled and what was once ideal *C. grenadensis* habitat was transformed into sub-marginal habitat with little contiguous crown vegetation along the transect worked in 1993. By 2010, however, the transect was again wooded along its entire length, but the composition and structure had changed dramatically. Fifty 10-m transect sections (out of a possible 122) harbored mango trees in 1993, yet only four did so in 2010. Additionally, 29 sections had evidence of sugarcane cultivation in 1993 compared to none in 2010, and 31 sections had breadfruit trees in 1993, but only one in 2010. In 1993, only 33 sections were 100% uncultivated while all 122 sections were uncultivated in 2010. Although anoles were still common throughout the transect in 2010 and rodents were frequently observed, the mean number of treeboa observations/night was 1.6 ± 0.2 (range = 0–3) compared to 9.5 ± 0.7 (5–15) in 1993. Searches for treeboas in nearby (25–50 m distant) stands of trees that were not devastated by Ivan (but separated from the study transect by treeless areas or solitary trees) quickly produced more boas than extensive searches along the transect, strongly suggesting that vegetation composition and structure are critically important elements of *C. grenadensis* habitat.

I first started doing treeboa surveys on Grenada in 1988. These initial surveys were undertaken merely to get some idea as to what kinds of habitats the snakes preferred, and what kinds were avoided. My early impressions were that *C. grenadensis* occurred almost everywhere and in almost any conceivable habitat on the island. Over time and many visits to Grenada, my impressions were refined. Treeboas did indeed occur in a wide variety of habitats (i.e., in 12 of 18 land-use categories; Henderson 2002: Table 3.1), often in proximity to human activity, but they did not occur everywhere. Nevertheless, before attempting this exercise, I would have thought treeboa numbers to be much higher than my calculated total. However, edge habitat, although certainly not uncommon, is limited. Grenada has about 31,100 ha of surface area and, based on my methods, only 1.2% of that area is potential habitat for *C. grenadensis*. My estimates might be (and hopefully are) conservative, but I am convinced that treeboas in Grenada do not occur in the tens of thousands, but, at best, in the relatively low thousands (8,000–15,000), and that suitable edge habitat is the limiting factor impacting both distribution and their numbers.

Acknowledgments

I thank Mr. Michael Mason, Land Use Officer in the Ministry of Agriculture, Forestry, and Fisheries for providing critical information on roads and rivers in Grenada. Thanks also to Mr. Aden Forteau, Head, Forestry Division, who prompted this exercise by asking me how many treeboas occur on Grenada. Mike Pauers provided helpful advice, Craig Berg, Josh Kapfer, and Rich Sajdak noted numerous shortcomings in this exercise, and Bob Powell provided editorial options. I have been fortunate to work with a wonderful cohort of associates over the years in Grenada, including Craig Berg, Joel Friesch, Ky Henderson, Rose Henderson, John Murphy, Rich Sajdak, and Al Winstel.

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JOHN PIOMAN

An alternate, uncommon defensive body-coiling configuration in *Amphiuma tridactylum*; note the head and tail protruding from underneath. Food items, Earthworms (*Lumbricus* sp.) and Red Swamp Crayfish (*Procambarus clarkii*) are present.

Body-coiling Behavior in the Three-toed Amphiuma (*Amphiuma tridactylum*)

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Salamanders coil their bodies for a variety of reasons, but primarily as a response to predators. For the aquatic salamander *Amphiuma*, all reports on coiling are associated with nest attendance, although another notion has made it into the literature, that *Amphiuma* coils its body to reduce evaporative water loss of the adult. We inadvertently tested this notion via another study on temperature preference in an aquatic thermal gradient. Because nearly half of our observations were of tightly coiled individuals underwater, we conclude that this behavior is not for reducing evaporative water loss, but more likely a defensive posture.

Body-coiling behavior has been reported in salamanders, primarily in plethodontids. However, the "tightness" of these coils is presumably limited by their skeletal morphology and relatively short body length. Coiling in plethodontids is generally 1–2 loosely coiled body loops, or as an "S" shape. A variety of explanations for coiling behavior have been suggested for plethodontids, including removal of cover, springing or leaping (Wake 1996), rolling downhill (García-París and Deban 1995), exposure to toxins (Brodie 1977), and reduction of evaporative water loss (Hillman et al. 2009).

Body-coiling also has been reported for species in the family Amphiumidae, and has always been associated with reproduction. All reports describe a presumed female discovered in mud under a previously submerged log, coiled in a single loop around eggs in both *A. means* (Davison 1895, Weber 1944, Seyle 1985) and *A. tridactylum* (Hay 1888,

JOHN POLMAN

Fig. 1. Non-nesting body-coiling behavior in *Amphiuma tridactylum*. This tight coiling occurs underwater, is presumed defensive, and differs from the loose coiling associated with nesting.

Baker 1937, Baker 1945, Tinkle 1959). Conversely, Hillman et al. (2009) and Duellman and Trueb (1994), citing Ray (1958), indicated that *Amphiuma* tightly coils its body and tail to reduce evaporative surface area and thus water loss. However, the word "*Amphiuma*" does not occur in the Ray (1958) reference, and thus we believe this reference and/or concept to be in error. Here, we describe the nature of body-coiling in *Amphiuma*, and test the notion of an evaporative-water-loss reducing function.

Materials and Methods

During the course of another study on temperature preference in a laboratory thermal gradient, we inadvertently tested whether body coiling is a mechanism to reduce evaporative water loss. We collected *A. tridactylum* (n = 15) by hand at night from East Baton Rouge Parish, Louisiana from April through May 1990. For determining temperature preference, an aquatic thermal gradient was created by dividing an aquarium into five water-filled sections at temperatures of 22, 26, 28, 31, and 35 °C. Prior to each experimental trial, the aquatic thermal gradient was drained and rinsed with well water to remove any olfactory cues left by other animals. The aquatic gradient consisted of an aquarium (125 x 38 x 34 cm) with five sections (25 x 38 x 9 cm) formed by four glass dividers (9 cm high). Each pool was aerated to provide circulation of oxygenated water and to maintain a more uniform temperature within each pool. The gradient was kept in a dark room to eliminate possible light cues, because these salamanders utilize mostly underwater burrows in turbid water. Each individual was placed randomly in one of the five pools at the beginning of each trial. Each experimental trial consisted of observing one individual for behavior, and recording the selected water temperature and body position every 30 min for 6 h (1100–1700 h).

Results

In 95 of the 205 observations (46%) of thermal selection within the gradient, individuals were positioned in a tightly coiled posture of 3–4 body loops with the head positioned at the bottom of the spring-shaped coil (Fig. 1). We noted some variations, including a knot-like configuration (figure on p. 134), but the head was always underneath. In the other 110 observations, the individuals were lying across the bottom in a more natural sprawled position, typical of that observed in the field (Figs. 2 & 3).

Discussion

All of our laboratory and field observations were of animals in water, suggesting that the body-coiling behavior observed here was not being used to reduce evaporative water loss. The body-coiling behavior we observed in *A. tridactylum* instead was probably attributable to an inability to find concealment. Accordingly, this behavior might be a defensive posture, as it reduces exposed surface area from an otherwise very elongate body position. The senior author has observed this behavior hundreds of times over many years with individual *A. tridactylum* and *A. means* being transported to the lab in a bucket or other container with water, as well as in an aquarium without cover. Anecdotal observations suggest that if a cover item is provided, the animals uncoil and use the provided cover — and we have not observed tight body-coiling behavior when cover is available, nor in the field under any condition. Virtually all individuals, males, females, and juveniles, found under cover in the field were typically in a mud depression with a single loose body loop, and generally remained that way unless disturbed (CLF, pers. obs.). On the other hand, the concept that tight body coiling could be used to reduce evaporative water loss is plausible. Given that *Amphiuma*

JOHN POJMAN

Fig. 2. *Amphiuma tridactylum* in natural mud/muck habitat in Baton Rouge, Louisiana. This individual was placed on the surface for photographic purposes because these salamanders normally are aquatic/fossorial and nocturnal, and it indeed burrowed into the mud and disappeared. Note the bite marks from another *Amphiuma* visible on the skin, as well as an old tail injury.

Fig. 3. *Amphiuma* live in crayfish burrows, and often hunt with their head at the entrance to take passing prey. This individual was coaxed out of the burrow by twiddling a stick at the water's surface to mimic an insect.

often live in ditches, ponds, and lakes that are susceptible to drying (Aresco and Gunzburger 2004, Gunzburger 2003), it is easy to imagine the benefit of such a behavior in a drying burrow during aestivation. However, no currently available evidence supports that contention. The very different coiling behavior associated with *Amphiuma* reproduction, with one loose coil around an egg mass on land, probably does reduce evaporative water loss of the eggs. In that case, the eggs are held together in a pile surrounded by the adult, thereby reducing the surface/volume ratio of the egg mass (Hayes and Lahanas 1987). Because our observations were incidental via another study, we did not specifically test the effect of cover availability on body-coiling behavior, and we suggest this as a future study.

Acknowledgements

We thank Sean Doody for assistance in the field.

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Spotted Salamander (*Ambystoma maculatum*) larvae metamorphosed and began exhibiting characteristics consistent with the chytrid-induced symptoms observed in Ozark Zigzag Salamanders (*Plethodon angusticlavius*).

Morphological and Behavioral Changes of Salamanders Infected with Amphibian Chytrid Fungus (*Batrachochytrium dendrobatidis*)

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Photographs by the senior author.

Amphibian Chytrid Fungus (*Batrachochytrium dendrobatidis*) or Bd has been associated with worldwide amphibian declines and mortality (e.g., Berger et al. 1998, Daszek et al. 2003, Lips et al. 2006). In frogs, the fungus is known to cause gross skin sloughing (Berger et al. 1999), as well as behavioral changes in posture, loss of righting reflex, and lethargy (Carey et al. 2006, Berger et al. 1999). Chytrid also has been found in several salamander species (e.g., *Cryptobranchus alleganiensis*, Briggler et al. 2007; *Eurycea* spp., Gaertner et al. 2009; *Ambystoma tigrinum*, Davidson et al. 2003), including some species that are completely terrestrial (*Plethodon neomexicanus*, *Desmognathus conanti*, Cummer et al. 2005, Timpe et al. 2008; *Batrachoseps attenuatus*, Weinstein 2009), although the prevalence of chytrid in wild populations usually is low (Hossack et al. 2010). Individuals that are infected typically have dark molts that contain Bd zoosporangia (Cummer et al. 2005, Davidson et al. 2003). Other documented symptoms have sometimes included dark spots on the venter (Davidson et al. 2003), frequent and dark molting (Montanucci 2009), flakes of unshed skin around the vent (Cummer et al. 2005), redness on the ventral surface of the digits (Vasquez et al. 2009), skin lesions (Brodman and Briggler 2008), and foot- and limb-loss (Brodman and Briggler 2008). None of these studies, however, reported any behavioral changes associated with chytrid infection. Herein, we describe morphological and behavioral changes that we observed among laboratory-housed salamanders that were infected with the chytrid fungus.

Fig. 1. An adult Ozark Zigzag Salamander (*Plethodon angusticlavius*).

Collection and Maintenance of Salamanders

During October 2008 through February 2009, we collected 86 Ozark Zigzag Salamanders (*Plethodon angusticlavius*; Fig. 1) from a site in southwestern Missouri. In March and April 2009, we collected 46 additional individuals from a site in northern Arkansas. We then transported the salamanders to our laboratory to be used in behavioral experiments. The salamanders were housed in plastic Petri dishes with moist filter paper in an environmental chamber at 17 °C with a 12:12 light-dark cycle (Fig. 2). Salamanders were initially sized and sexed and then fed 4–8 flies (*Drosophila melanogaster*) three times per week. Filter paper was changed biweekly.

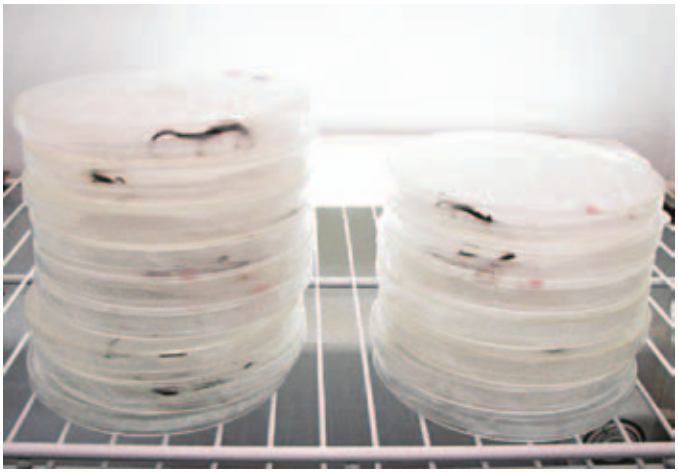

Fig. 2. Ozark Zigzag Salamanders (*Plethodon angusticlavius*) housed in Petri dishes with moist filter paper inside an environmental chamber.

Chytrid-induced Mortality and Treatment

In April 2009, several salamanders died from unknown causes. After the rate of mortality increased sharply in May (Fig. 3), we sent six preserved specimens to Pisces Molecular (Boulder, Colorado) for chytrid testing, and all six tested positive. In July, we began treating the salamanders with an antifungal medication (Itraconazole, aka Sporanox). The salamanders were bathed for 5 min on 11 consecutive days in a 0.01% solution with the addition of 0.6% saline. This treatment has been successful for other chytrid-infected amphibians (Forzan et al. 2008). In our laboratory, these treatments also appeared to be mostly successful, evidenced by the reduction of mortalities. After 11 days, we continued to treat salamanders that displayed chytrid-like symptoms (discussed below) until the symptoms ceased or mortality occurred. In total, slightly over half of the salamanders died by December 2009, at which point the remaining salamanders appeared to be healthy. Many of these mortalities occurred before the Itraconazole treatments began; of the salamanders that were treated, approximately 75% survived, but we do not know how many actually were infected with chytrid.

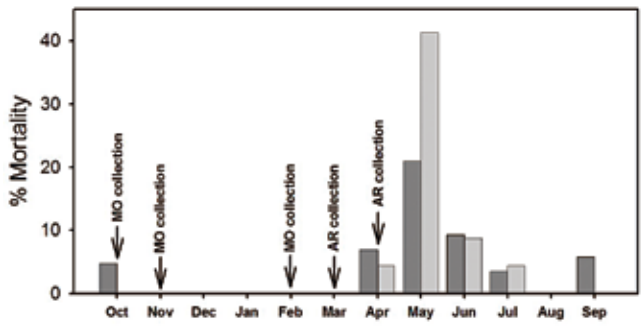

Fig. 3. The percentages of mortality in laboratory-housed Ozark Zigzag Salamanders (*Plethodon angusticlavius*) collected from a site in Missouri (dark gray bars) and a site in Arkansas (light gray bars) during fall 2008 and spring 2009.

Prior to the chytrid-induced mortality in our laboratory in March 2009, we collected several Spotted Salamander (*Ambystoma maculatum*) eggs (Fig. 4) from a site in southwestern Missouri. Eighty larvae (Fig. 5) hatched, and we housed them in aquaria with aerated pond water. The larvae metamorphosed around June 2009 into juvenile salamanders (Fig. 6), and we housed them in Petri dishes lined with moist filter paper that we kept in the environmental chamber with the Ozark Zigzag Salamanders. Subsequently, several Spotted Salamanders died after exhibiting symptoms of chytrid (discussed below). Once individuals began exhibiting symptoms, we initiated anti-fungal treatments — and about 25% of the treated salamanders recovered. This suggests that waiting until salamanders become symptomatic to begin treatments may be too late to achieve a high success rate.

Other studies have reported high mortality of chytrid-infected salamanders in the laboratory. In one study on a terrestrial salamander (*Batrachoseps attenuatus*), laboratory mortality was 100%, whereas wild populations appeared stable according to seasonal variation (Weinstein 2009). An experimental study on another species (*Plethodon metcalfi*) found laboratory mortality rates of 41.7% at 8 °C and 8.3% at 16 °C (Vasquez et al. 2009).

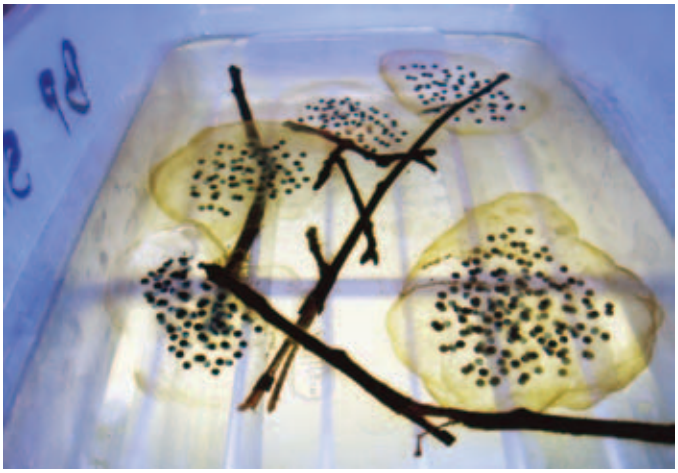

Fig. 4. Spotted Salamander (*Ambystoma maculatum*) egg masses collected from a pond in Missouri and housed in an environmental chamber.

Fig. 5. A larval Spotted Salamander (*Ambystoma maculatum*) housed in an aquarium

Morphological and Behavioral Changes

During the period when the salamanders were ill, obvious morphological changes in Ozark Zigzag Salamanders included sloughing large amounts of skin that were dark in coloration, and occasional loss of part or all of the legs (Fig. 7A). These salamanders also displayed behavioral anomalies char-

Fig. 6. Juvenile Spotted Salamanders (*Ambystoma maculatum*) that had recently metamorphosed in our laboratory.

acterized by raising part of their body as if to avoid contact with the substrate. Specifically, the salamanders would raise their tail (Fig. 7B) or trunk (Fig. 7C) much like the posture that is typically seen during an aggressive display in territorial contests (Jaeger 1984). They also were observed frequently raising their legs (Fig. 7D). In severe cases that typically led to mortality, these behavioral symptoms would progress until the salamanders had difficulty walking (video posted at: www.facebook.com/video/video.php?v=706655963964).

Similar to the Ozark Zigzag Salamanders, the Spotted Salamanders that were infected also shed large amounts of skin (Fig. 7E). In some cases, it appeared that the salamanders eventually died from internal hemorrhaging (Fig. 7F). This occurrence matched the recent discovery that chytrid-induced mortality results from asystolic cardiac arrest (Voyles et al. 2009). In contrast to the symptoms of the Ozark Zigzag Salamanders, we observed no obvious behavioral symptoms in infected Spotted Salamanders, although the speed of their righting responses appeared to be greatly reduced. Thus, we used both skin sloughing and decreased righting response as indicators of infection to determine whether individual salamanders would be treated with Itraconazole.

What was the source of the chytrid?

We do not know how the chytrid entered our laboratory. The Ozark Zigzag Salamanders that we collected were the first to display chytrid-like symptoms in our laboratory, but we cannot be certain they were the original source of the infection. Once the chytrid was in the laboratory, we probably were responsible for spreading it among salamanders. This contamination was likely facilitated by our lack of sterilization of some laboratory equipment and testing chambers.

Conclusions

To our knowledge, the only prior reports of chytrid in the Ozarks are from a stream salamander (the Hellbender, *Cryptobranchus alleganiensis*; Briggler et al. 2008) and from frogs (*Lithobates* spp.) and salamanders (*Eurycea* spp.) in caves (Rimer and Briggler 2010). The source of the chytrid in our laboratory was either terrestrial, via the Ozark Zigzag Salamanders, or from ponds, via either the Spotted Salamanders or Central Newts (*Notophthalmus viridescens louisianensis*), which we also housed in the laboratory. Whatever the source, Ozark Zigzag Salamanders and Spotted Salamanders are susceptible to chytrid, and can die following infection. Chemical treatments of these two species with Itraconazole were somewhat effective; however, some recent research has found that temperature treatments on amphibians can be highly effective (Woodhams et al. 2003, Márquez et al. 2010, Briggler et al. 2009).

Acknowledgements and Ethical Note

These salamanders were originally brought into our laboratory (Missouri Department of Conservation permits 13611 and 13966 and Arkansas Game and Fish Commission permit 101420081) for research that was approved by Missouri State University's IACUC (protocols 2007M and 2008AA). Because these salamanders were exposed to chytrid, we did not return them to the wild; instead, they were euthanized in accordance with officials from MDC, AGFC, and MSU's IACUC. Since the occurrence of these infections, we have worked to prevent future chytrid-related problems in our laboratory. We have improved procedures for quarantining wild-caught individuals and for cleaning and disinfecting equipment, and, since 2009, no further evidence of chytrid has occurred in our laboratory. We are especially grateful to the following people for their assistance and expertise:

Fig. 7. Chytrid-induced morphological (A) and behavioral (B, C, D) changes in Ozark Zigzag Salamanders (*Plethodon angusticlavius*), and morphological changes (E, F) in Spotted Salamanders (*Ambystoma maculatum*).

Mark Wanner (St. Louis Zoo), Jeff Briggler (MDC), Kelly Irwin (AGFC), and Michael Stafford (MSU IACUC). We also thank Jenny Parsons and Rob Hunt for help performing chytrid treatments, and Allison Overmeyer for help with euthanasia.

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MIGUEL A. LANDESTOY

The Hispaniolan Green Treefrog (*Hypsiboas heilprini*) occurs in both the Dominican Republic and Haiti and is Vulnerable according to the IUCN Red List. Recommended actions include *in situ* conservation and conservation education.

Amphibian Conservation Needs Assessment Workshop for the Caribbean Region

Kevin Johnson

Taxon Officer, Amphibian Ark (kevinj@amphibianark.org)

In March 2011, Amphibian Ark staff facilitated two Amphibian Conservation Needs Assessment workshops in Santo Domingo, Dominican Republic. The first workshop, which also included the updating of many Red List Assessments, focused on species from Haiti, the Dominican Republic, and Jamaica. The second workshop assessed amphibians from Puerto Rico and Cuba, plus a few species from the Lesser Antilles.

During the nine days, 16 field experts and observers worked with staff from the AArk, IUCN Amphibian Specialist Group, and Conservation International, with various sub-groups being formed as necessary to tackle multiple assessments at the same time.

Participants assessed 178 amphibian species for their conservation needs. Of these, 54 species occur in Haiti, 44 in the Dominican Republic, 24 in Jamaica, 62 in Cuba, 22 in Puerto Rico, and 6 in the Lesser Antilles. The assessment process resulted in the following recommendations (Table 1): 25 species are in need of *ex situ* rescue programs; 112 species could still be saved in the wild with *in situ* conservation action; 41 species require further *in situ* research to determine more about the species population status and/or the threats they face; 78 species are currently undergoing or are proposed for specific *ex situ* research that contributes to the conservation of the species or a related species; 90 species are suitable for either *in situ* or *ex situ* conservation education programs; and 26 species were recommended for cryopreservation. Only 12 species were not recommended for any conservation action. More detailed conservation action reports are available on Amphibian Ark's data portal (www.amphibianark.org/assessmentresults.htm). Additional field experts are needed to complete assessments for the Lesser Antilles and Trinidad & Tobago. Data sheets will be updated as additional assessments are made.

RAFAEL JOGLAR

The second Amphibian Conservation Needs Assessment workshop included participants with expertise in species from Cuba, Puerto Rico, and the Lesser Antilles. Left to right: Sixto Incháustegui, Luis Díaz, Richard Gibson, Rafael Joglar, Kevin Johnson, Ariel Rodríguez Gómez, Alberto R. Estrada, and Craig Berg.

LUIS DÍAZ

Participants at the joint Amphibian Red List and Conservation Needs Assessment workshop covering species from Haiti, the Dominican Republic, and Jamaica. Standing left to right: Sixto Incháustegui, Craig Berg, Marcos Rodríguez, Luis Díaz, Joel Timyan, Cristian Marte, Richard Gibson, Iris Holmes, Eveling Gabot, Miguel Landestoy, and James Lewis; kneeling: Ariadne Angulo and Kevin Johnson.

Participants then discussed options for implementing the various conservation actions identified during the workshop. Volunteers were identified in each country to be the focal point for continued actions, assessment updates, and to encourage amphibian conservation activities. These persons are Susan Koenig and Iris Holmes for Jamaica, Rafael Joglar for Puerto Rico, Sixto Incháustegui for the Dominican Republic, Luis Díaz and Ariel Rodríguez for Cuba, Joel Timyan for Haiti, and Craig Berg and Richard Gibson for the Lesser Antilles (Grenada and Dominica, respectively).

The last day of the workshop was devoted to discussions of *ex situ* amphibian husbandry issues, with many examples of both simple and sophisticated facilities shown and discussed. Participants found this particularly helpful, and they gained many good ideas to put into practice at their own facilities.

Acknowledgements

Adrell Núñez from the Parque Zoológico Nacional (ZooDom) and Miguel Landestoy provided an opportunity to experience a little of the local flora and fauna during the workshop. Several species of frogs, lizards, and snakes were observed during a nocturnal walk around ZooDom, a field trip to a wonderful cloud forest in the 23-km^2 protected area Reserva Científica de Ébano Verde, and a night-time trip to the Santo Domingo Botanical Garden. The Mohamed bin Zayed Species Conservation Fund provided support for this workshop.

MIGUEL A. LANDESTOY

The Jarabacoa Burrowing Frog (*Eleutherodactylus bothroboans*) from the Dominican Republic was until recently considered a subspecies of *E. ruthae*, which is Red-Listed as Endangered. Recommended actions include *in situ* conservation, *ex situ* research into breeding requirements, and conservation education.

MIGUEL A. LANDESTOY

The recommended action for the endangered Hispaniolan Wheeping Frog (*Eleutherodactylus minutus*) from the Dominican Republic is *in situ* conservation.

Table 1. Recommended conservation actions for Caribbean frogs.

Haiti	
Rescue	10 species
In situ conservation	41 species
In situ research	17 species
Ex situ research	20 species
Conservation education	20 species
Cryopreservation	10 species
No conservation action required	2 species
Dominican Republic	
Rescue	4 species
In situ conservation	29 species
In situ research	8 species
Ex situ research	17 species
Conservation education	20 species
Cryopreservation	4 species
No conservation action required	1 species
Jamaica	
Rescue	1 species
In situ conservation	4 species
In situ research	10 species
Ex situ research	6 species
Conservation education	6 species
Cryopreservation	1 species
No conservation action required	8 species
Cuba	
Rescue	3 species
In situ conservation	45 species
In situ research	8 species
Ex situ research	41 species
Conservation education	34 species
Cryopreservation	3 species
No conservation action required	1 species
Puerto Rico	
Rescue	7 species
In situ conservation	6 species
In situ research	1 species
Ex situ research	8 species
Conservation education	22 species
Cryopreservation	7 species
Lesser Antilles (only 6 species assessed)	
Rescue	1 species
In situ conservation	4 species
Ex situ research	2 species
Conservation education	5 species
Cryopreservation	1 species

RAFAEL JOGLAR

The Puerto Rican Frog (*Eleutherodactylus coqui*) is of Least Concern on the IUCN Red List. Recommended actions include *ex situ* research (as this species is a good husbandry analog for other direct-developing species) and conservation education.

RAFAEL JOGLAR

Recommended actions for the critically endangered Puerto Rican Bronze Frog (*Eleutherodactylus richmondi*) include rescue, *ex situ* research, conservation education, and cryopreservation.

JOHN BINNS

Male Ricord's Iguanas (*Cyclura ricordii*) can reach 485 mm SVL and 4.2 kg. The distinctive whorls around the tail easily distinguish these iguanas from sympatric Rhinoceros Iguanas (*C. cornuta*), even at a distance.

Discovery of Ricord's Iguana (*Cyclura ricordii*) in Haiti

Ernst Rupp and Masani Accimé

Grupo Jaragua Inc., Santo Domingo, Dominican Republic

Ricord's Iguana (*Cyclura ricordii*) is listed as Critically Endangered (CR) on the IUCN Red List (Ottenwalder 1996). The species is endemic to Hispaniola and is considered a flagship species in a "hotspot" region of high biodiversity and endemism. Until recently, the species had been known to exist only in the Jaragua-Bahoruco-Enriquillo Biosphere Reserve of the southwestern Dominican Republic (Fig. 1), where it is restricted to the arid Valle de Neiba and the most xeric portion of the coastal lowlands on the Península de Barahona (Ottenwalder 1999). The presence of Ricord's Iguanas in the Haitian extension of the Neiba Valley plain had been presumed by Schwartz and Carey (1977), but the species had never been recorded within Haiti from either the Lake Étang Saumâtre Basin or the dry coastal fringe extending from Anse-à-Pitres to Marigot across the Dominican border from Pedernales (Ottenwalder 1999).

Since 2003, Grupo Jaragua has been monitoring the only previously known population of *C. ricordii* on the Península de Barahona, which occupies an area east of Pedernales and north of Cabo Rojo, inside the fork of the Oviedo-Pedernales and Cabo Rojo-Acetillar roads (Figs. 1 & 3). The area consists of a series of broad, flat plains punctuated by rocky outcrops and marine terraces with very fine soil covering exposed limestone (Ottenwalder 1999). Ricord's Iguanas prefer to dig their burrows in so-called "fondos," which are depressions in limestone rock filled with deep reddish clays. When soil is unavailable, rock cavities are used for retreats. During our monitoring work, we noticed that active iguana retreats in the grayish weathered rock could be detected by a whitish-colored ring. This trait makes it possible to spot active dens even from a distance. As iguanas dig, they scratch the weathered limestone with their claws, rendering it white and creating the ring. Burrows dug by Rhinoceros Iguanas (*C. cornuta*), which are broadly sympatric with *C. ricordii* throughout the latter's range, lack this feature.

Looking west toward Haiti from the town of Pedernales, one can see a topography of limestone terraces similar to that in which *C. ricordii* is present on the Dominican side. In October 2005, we questioned residents in the town of Anse-à-Pitres, Haiti, and discovered that many had seen iguanas in the limestone terraces west of the town. Furthermore, at least one iguana hunter indicated that he was able to distinguish between the two types of iguanas. On 8 November, with a youth group from Anse-à-Pitres, we set out to visit the terraces. Despite evidence of heavy impact by animal grazing and charcoal production, considerable vegetation in the form of cacti, small bushes, herbs, and grasses remained. In Kachiman, which consists of plantain fields on alluvial clay, we saw at a distance of

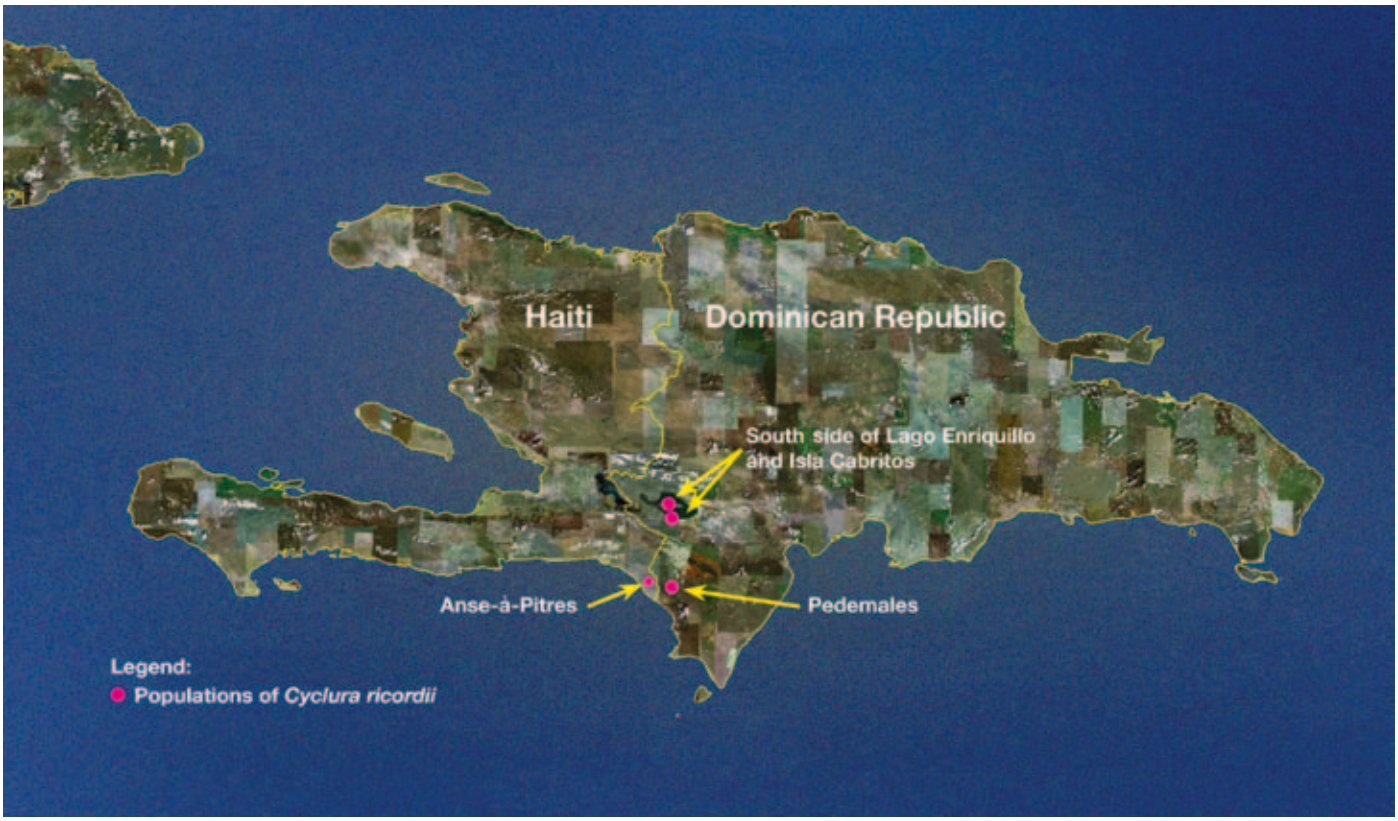

Fig. 1. Locations of Ricord's Iguana (*Cyclura ricordii*) populations on Hispaniola.

about 70 m, along the foot of one of the terraces in a steep rock wall, what appeared to be an active Ricord's Iguana den with its typical whitish ring (Fig. 2). Around 0900 h, an iguana's head slowly appeared at the entrance. With binoculars we confirmed that this was a Ricord's Iguana — and a big one at that. The animal did not completely leave its den. It certainly had spotted us. Frequent human presence in the area causes iguanas to be very shy. Moving nearly a kilometer along the lower part of the terrace, we spotted another animal, approximately 100 m away in a steep rock wall. Only the tail and part of the body were visible, but again with the help of the binoculars, the species' characteristic tail rings could be detected. This animal was also a *C. ricordii*. On the way back to town, we also saw three basking Rhinoceros Iguanas.

During follow-up visits, we encountered the same two *C. ricordii* on several occasions, although we were never able to take any reliable photos because of the distance. In February 2007, we were visited by Tom Wiewandt, who has intensively studied *C. stejnegeri* on Mona Island. We hoped that with his excellent gear, especially a huge telescopic lens, we could finally get photographic proof. As we approached the first den, the large iguana was just lying there in perfect position for a star photo. Tom got his equipment ready and took one more step to get into a better position for the shot. Before he was able to touch the button on the camera, the iguana disappeared in its den.

Clearly, the Ricord's Iguanas in the Anse-à-Pitres area were few in number and holding on only in places not easily accessible by people, almost certainly a reflection of intense hunting pressure. Was this small population about to be extirpated? One requisite for its survival would be suitable nesting grounds with proven female activity during the reproductive season. Again, for comparison, we looked at Pedernales, where the

MASANI S. ACCIMÉ

Fig. 2. An active Ricord's Iguana den in a limestone terrace.

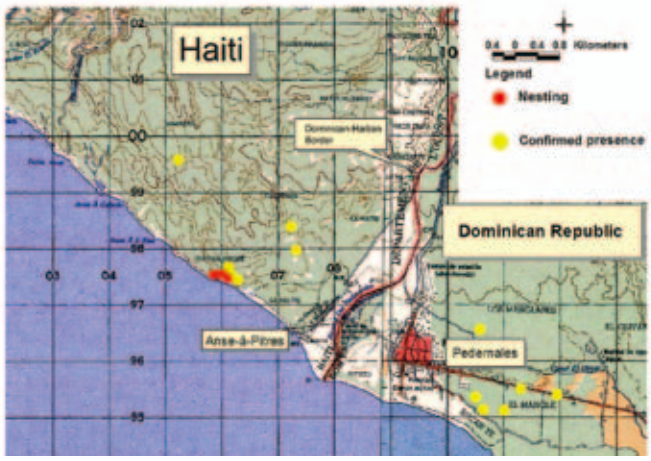

Fig. 3. The area of Anse-à-Pitres and Pedernales, dots mark sites where the presence of *Cyclura ricordii* has been confirmed.

fondos, with their terra rossa, were typical nesting grounds for *C. ricordii*. We concluded that all we had to do was look for similar fondos in Anse-à-Pitres. Google Earth® satellite images provided evidence of several smaller fondos within the limestone terraces where we had spotted the iguana dens. During the 2006 and 2007 nesting and hatching season, we visited these possible nesting areas, but never found evidence to indicate that Ricord's Iguanas were nesting there.

At this point, we had given up on finding any nests, and we thought that the animals we had seen in the limestone terraces were the last survivors of a doomed population. However, on 19 May 2008, during a visit to a reforestation project in Anse-à-Pitres, one of our youth collaborators approached us, opened a bag with a triumphant smile, and pulled out four eggs. Based on size and shape, they were Ricord's Iguana eggs. We were stunned. Although their removal from the nest meant that the embryos would not survive, the boy had found a nest and, therefore, a nesting ground. We followed him to where he had excavated the eggs, and to our surprise the excavation had not taken place in a fondo with red clay. Instead, we found a beach with fine grayish white sand, the same substrate used by Ricord's Iguanas in the Neiba Valley.

Table 1. Ricord's Iguana nests documented in 2010 in the Lasalin habitat, Anse-à-Pitres, Haiti. Nests for which egg numbers are not indicated (marked with —) were not verified.

Nest #	Poached	Emergence Hole	Eggs hatched/ not hatched
N1	yes	yes	20/0
N2	no	no	—
N3	yes	no	0
N4	yes	no	—
N5	no	yes	—
N6	no	yes	0
N7	no	yes	—
N8	yes	no	0
N9	yes	yes	5/0
Unmarked 1	no	yes	4/0
Unmarked 2	no	yes	—

Fig. 4. Satellite image of the *Cyclura ricordii* habitat at Lasalin near Anse-à-Pitres, Haiti (Google Earth®).

The sandy beach is called Lasalin, and is about the size of a football field (Fig. 4). We started looking around and soon detected a recently evacuated nest, which could be recognized by the pure white sand brought to the surface (Fig. 5). During the following two weeks, we found a total of nine nests, seven of them complete, and two excavated. We also were able to spot a gravid female. During the hatching season from July to September 2008, we were unable to visit the beach to evaluate hatching success.

The International Iguana Foundation supported a workshop on 22–24 August 2009, during which the presence of *C. ricordii* was further documented. The purpose of the workshop was to learn how to apply methods for estimating population size, hatching success, and survival rate at different life stages. Led by iguana specialist Stesha Pasachnik, we set up a hands-on workshop in known *C. ricordii* habitats in Pedernales, and visited the habitat in Anse-à-Pitres. Participants included Dominican and Haitian field guides and assistants. Our goal visiting the Anse-à-Pitres site was for individuals participating in the workshop to discuss the quality of this habitat and the potential for the presence of a substantial population, and to excavate potential nests. We excavated several successful nests. Hatched eggshells were recovered from subterranean burrows 45–60 cm deep, and, based on size, shape, and consistency of the shells, they were clearly those of *C. ricordii*. Hatching success was 100% in two of these nests. As if to further prove the presence of the species in Haiti, two underdeveloped *C. ricordii* fetuses were recovered from one nest, and were identified based on the species' classic tail-ring characteristics.

In September and October 2009, with the help of a local youth group, we conducted a socioeconomic study investigating human impact on the Ricord's Iguana population in Anse-à-Pitres. The 502 surveys yielded results critical in developing the next steps to conserve the species. However, while conducting the surveys, the Lasalin nesting site was nearly destroyed. On 15 September, one of the Haitian field guides saw a road being excavated on the edge of Anse-à-Pitres, and it was headed directly toward Lasalin. Inquiries determined that the work had been ordered by a prominent person from Anse-à-Pitres, with the intent of mining sand for construction projects. Early the following morning, the guide and his father

Fig. 5. The first *Cyclura ricordii* nest in Haiti was found on sandy beach near Anse-à-Pitres.


MASANI S. ACCIMÉ

Fig. 6. Members of OJAA protecting Ricord's Iguana habitat in September 2009.


NELSON JEAN

Fig. 8. First photograph of a wild Ricord's Iguana (*Cyclura ricordii*) in Haiti.

confronted the construction workers and demanded they halt the work. The workers threatened violence with machetes. Meanwhile, the youth group, which was assisting us with the surveys, set up a tent at the nesting site and refused to leave (Fig. 6). The altercation ended without violence, but clearly demonstrated the vulnerability of the precious habitat, and how close the species was to being extirpated in Haiti! A few weeks after this incident, a local habitat surveillance and monitoring team was established.


MASANI S. ACCIMÉ

Fig. 7. Emergence hole in Anse-à-Pitres (top) and Masani Accimé and field assistant Nelson Jean with 20 eggs excavated from nest #1 (bottom).

This team regularly patrols the 4.5-ha habitat to prevent iguana hunting and tree-cutting for charcoal production. In addition to protecting iguanas, this vigilence clearly has benefited ecological biodiversity in the habitat.

During the 2010 *C. ricordii* nesting season, we closely monitored the Lasalin habitat. The March–June time frame and an incubation period of 90–100 days corresponded with data collected on the species in the Dominican Republic. We did not use external markers to identify the Lasalin nests, as we do in Pedernales, for fear of poaching. Last year, nine nests were found in the sandy habitat of Lasalin, and the location of each nest was identified only with GPS coordinates. Two additional nests were found once hatchlings had emerged, leaving behind emergence holes indicating the location of the nests (Fig. 7). Several nests were verified by excavation with 100% hatching success (Table 1). Several adult *C. ricordii* were subsequently seen in the area surrounding Lasalin, and we found additional active dens in the limestone outcrops on the northern edge of the nesting site. All dens had the characteristic ring. We found scat at the entrances as additional proof of activity, and one large adult was sighted scurrying into one of the dens. Nesting success for 2011 is still being evaluated.The habitat-monitoring team was given a special assigment to try and capture an image of *C. ricordii*, and, in April 2011, we finally got the first photograph of a wild *C. ricordii* in Haiti (Fig. 8).

We have been working diligently to educate the local community about this species and its significance. The local authorities have been


MASANI ACCIMÉ

Fig. 9. Habitat used by *Cyclura ricordii* near Anse-à-Pitres. The area in the background near the sea is the nesting area known as Lasalin.

ERNST RUPP

Fig. 10. In the past, drier Pleistocene climates might have allowed genetic exchange between the disjunct subpopulations north and south of the Sierra de Bahoruco. The total range of Ricord's Iguanas is <100 km², and less than 60% of the historical range is occupied — and even the occupied portions are disturbed to varying degrees.

informed of the status of the species through workshops, with an emphasis on the local and international importance of habitat conservation, and the possibility of legally creating a Municipal Wildlife Reserve. Educational materials have been created and distributed. The grave state of the Haitian *C. ricordii* population is evident through our monitoring of nesting activity. In sharp contrast to the site at Lasalin (Fig. 9), the population in Pedernales has 200 to 300 nests each year.

Conserving the small population of *C. ricordii* in Anse-à-Pitres is not only about saving the species from extinction in Haiti, it is about giving hope to a struggling country. The concept of wildlife and biodiversity conservation is completely new to the Haitian public, and it challenges the way they have been interacting with nature. Extreme poverty and decades of political turmoil and instability have pushed the people into charcoal production and subsistence farming, the only means for survival. Nevertheless, the idea of protecting these creatures is taking hold in this small rural town. Several local grassroots organizations, youth groups, and local guides have mobilized in this effort to conserve the species and its habitat. They affirm that the presence of *C. ricordii* could have long-term positive benefits for the community, and they are motivated to take ownership of these conservation activities (Fig. 10).

Acknowledgements

This work would not have been possible with out the diligent fieldwork of our local assistants Jairo Isaa Arache Matos, José Luis Castillo, Jehmson Athemas, Macathur Lafortune, Nelson Jean, and the members of the local Haitian youth group OJAA (Òganizasyon Jenès Aktif Ansapit) — making special note of the courage and dedication demonstrated by the Haitian team and participating youth group after the tragic January 2010 earthquake. Special thanks go to Rick Hudson and the International Iguana Foundation for their continuous financial, scientific, and moral support. We also thank the MacArthur Foundation, the Mohamed bin Zayed Species Conservation Fund, Disney Worldwide Conservation Fund, and the International Reptile Conservation Foundation for their financial support.

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ROBERT POWELL

An adult female San Salvador Curlytail (*Leiocephalus loxogrammus parnelli*) from scrub habitat near Rocky Point.

The Terrestrial Reptiles of San Salvador Island, Bahamas

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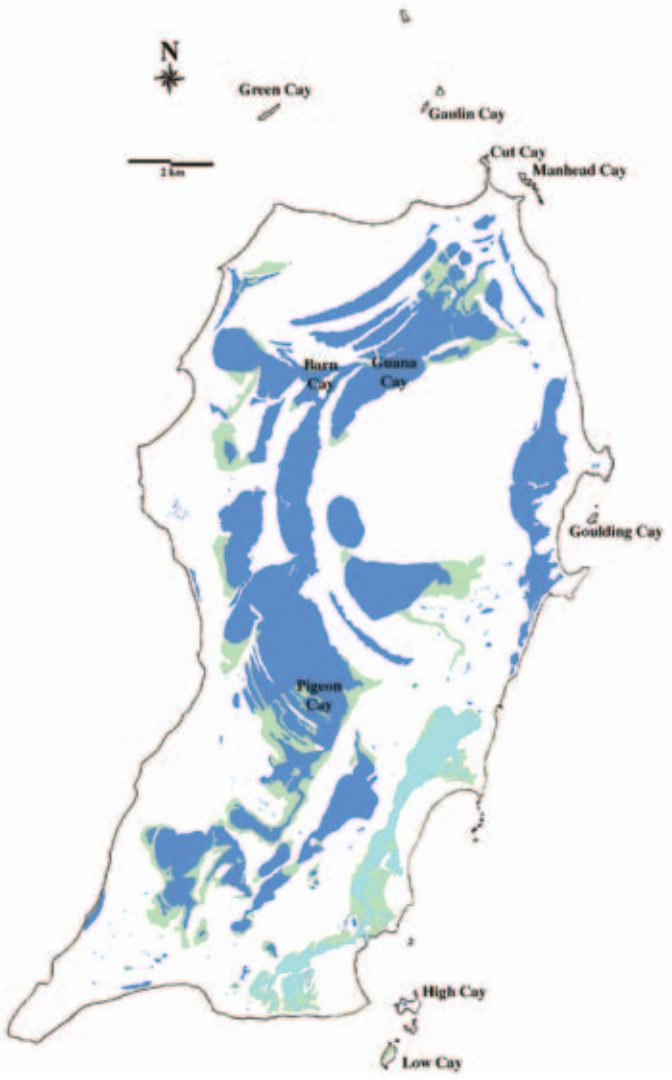
Originally named "Guanahani" by the Lucayan Indians, who were the first humans to settle the island, San Salvador is one of 700 islands that make up the Bahamian Archipelago (Gerace et al. 1998). Located at 24°3'N latitude and 74°30'W longitude, it is 640 km ESE of Miami, Florida. Temperatures range from 17–27 °C in the winter and 22–32 °C in the summer. Most of the island's mean annual rainfall of 100 cm falls during the May–November rainy season, with about one-fourth of the total associated with the annual hurricane season.



San Salvador, Bahamas, showing the inland system of lakes (dark blue), some associated wetlands (green), and a tidal creek (Pigeon Creek; light blue). Some sediment deposits are shown as wetlands. Labeled cays have supported San Salvador Rock Iguana (*Cyclura rileyi rileyi*) populations in recent years, although those on Barn Cay (1970s) and High and Gaulin cays (1990s) have been extirpated, and small populations have been introduced to the Club Med Resort on the main island and onto Cut Cay. Adapted from Robinson and Davis (1999).

ABBY TATE

The Dixon Hill lighthouse is situated on one of the higher elevations on San Salvador. The top of the lighthouse provides a view of the entire island.

One-third of the island's total surface area of 92.9 km^2 is comprised of a network of brackish (often hypersaline) inland lakes. Like the other Bahamian islands, San Salvador is a low carbonate island. The highest point is 37.5 m above sea level (Shaklee 1994). Soils are generally shallow, poorly developed, and retain little water. Vegetation is mainly "scrub," with most (~60%) plants of Caribbean origin, ~30% exotic Florida imports, and 6–8% endemics (Smith 1993).

Christopher Columbus probably first made landfall on San Salvador in Long Bay on 12 October 1492 (Gerace et al. 1998). The island, like most of the Bahamas, was completely depopulated by 1513 when Ponce de Leon passed through on his way to Florida. The British declared the

Bahamas a crown possession in 1629, but San Salvador was largely unaffected by Europeans until American colonists loyal to Britain were forced to immigrate to the Bahamas in 1783. They built impressive estates, using African slaves as labor. The "Loyalist Period" ended in 1834, when Great Britain abolished slavery. Descendants of slaves led a subsistence existence until the U.S. established military bases on the island in 1951, leaving a functional infrastructure when they departed in the 1960s. Today, tourism and the Gerace Research Centre employ the majority of the approximately 1,000 residents.

The six native terrestrial reptiles of San Salvador have evolved to cope with the harsh xeric habitats and the onslaught of tropical storms. Most are small (the San Salvador Rock Iguana is a notable exception) and divide much of their time between seeking shelter from the inhospitable conditions and foraging for food. A few, including one introduced lizard, have taken advantage of alterations to the natural habitats by exploiting

TIFFANY SCHULTHEIS

In 1680, a pirate named John Watling supposedly chose San Salvador as his retreat. Ruins known as Watling's Castle provided views of both eastern and western sides of the southern end of the island. As romantic as these tales are, local historian, Kathy Gerace, clearly demonstrated that the ruins are actually a late 18th-century Loyalist plantation house.

ABBY TATE

San Salvador Rock Iguanas (*Cyclura rileyi rileyi*) remain abundant on Green Cay, despite the introduction of *Cactoblastis* moths that destroy Prickly-pear Cacti (*Opuntia stricta*), a major food source. However, the population on the main island is almost extirpated as a consequence of exploitation, roadkills, the loss of habitat, and accidentally or intentionally introduced invasive species, notably Black Rats (*Rattus rattus*), feral cats (*Felis silvestris*), and dogs (*Canis familiaris*), all of which prey on adults, juveniles, or eggs.

PAUL A. HILLBRAND

Some individual iguanas on Green Cay emerge from shelters when tourists land.

PAUL A. HILLBRAND

This healthy female appears to be thriving far from the landing site.

human habitations and debris, but all have suffered to some degree from exploitation (iguanas), the loss of habitat, and accidentally or intentionally introduced invasive species, notably *Cactoblastis* moths, Fire Ants (*Solenopsis invicta*), Black Rats (*Rattus rattus*), and feral cats (*Felis silvestris*) and dogs (*Canis familiaris*) (Hayes et al. 2004).

The following annotated checklist covers only the terrestrial reptiles. In addition to these, at least one sea turtle, the Hawksbill (*Eretmochelys imbricata*), frequents the reefs and regularly nests in small numbers. Two native amphibians also occur (see the sidebar on p. 164), the Cuban Treefrog (*Osteopilus septentrionalis*) and the Bahamian Flathead Frog (*Eleutherodactylus rogersi*), and one non-native Squirrel Treefrog (*Hyla squirella*) has been observed (WKH and S. Buckner, sight record only). One incomplete snakeskin of a larger, non-native, non-boid species was also found in an outbuilding (WKH), but remains unidentified.

San Salvador Rock Iguana (*Cyclura rileyi rileyi*)

The best-known reptile of San Salvador, the Rock Iguana, is aptly named for its proclivity for rocky limestone terrain. It is endemic to San Salvador, but numbers have declined drastically since humans arrived. At present, fewer than 600 individuals remain, many are adults (suggestive of limited recruitment), and they are largely restricted to four tiny offshore cays and two small islets in a hypersaline lake (Hayes et al. 2004). These areas total about 31.5 ha, about 0.2% of the historical range. Together, Green and Goulding cays support more than two-thirds of the entire taxon. Only occasionally are iguanas encountered on the main island; some of these may be individuals purposefully relocated by island residents or lizards that swam ashore from the nearby cays when droughts exacerbated the already food-limited situation on the cays. Populations on Barn (in the 1970s) and High and Gaulin cays (in the 1990s) were extirpated. The Club Med resort on the mainland illegally procured individuals from Green Cay in the 1990s, but the population, protected by perimeter fencing, remains small (Hayes et al. 2004). A small population was also introduced from Green Cay to Cut Cay (five males, five females) in 2005, but it has not grown appreciably (unpubl. data).

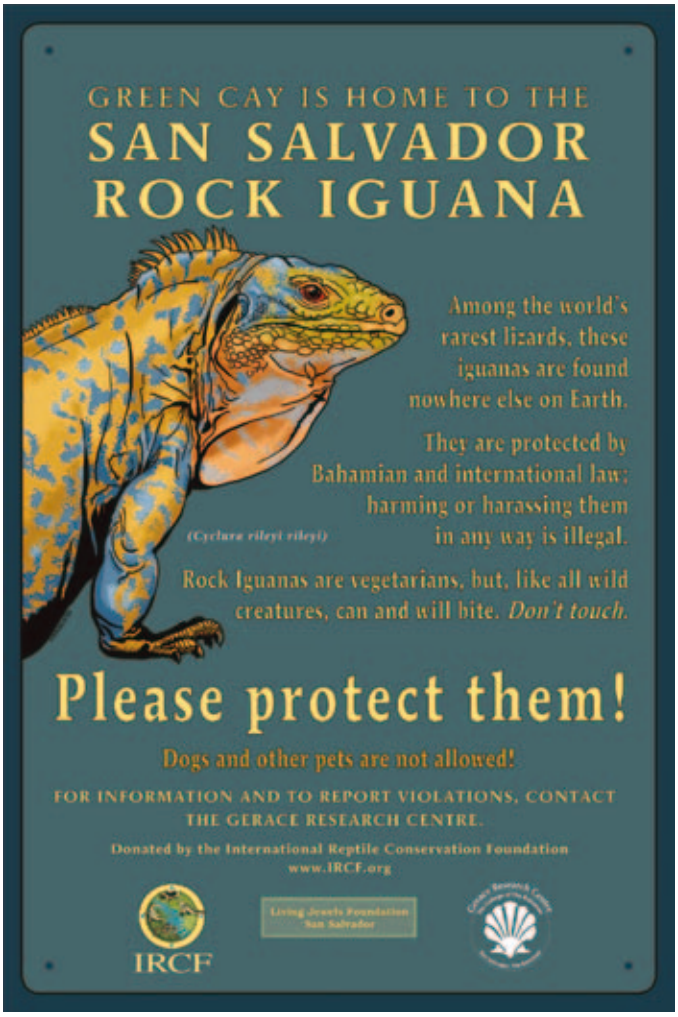
San Salvador's iguanas are smaller than most congeners; males reach a SVL of 306 mm and females 254 mm (Schwartz and Henderson 1991; c.f., Hayes et al. 2004). However, iguanas translocated to Club Med on the mainland, with lush vegetation, have attained substantially larger body sizes (unpubl. data). Color and pattern are variable. Ground color can range from greenish gray to tanish, with varying splotches of lighter green, red, orange, or yellow of increasing intensity toward the dorsal spine ridge. The pattern of ground and splotch colors is reversed in some animals. Males are generally more vivid than females. Juveniles range from solid brown to gray and have faint longitudinal stripes but lack the vivid splotches and chevrons seen on adults.

ROBERT POWELL

Like most iguanian lizards, San Salvador Rock Iguanas (*Cyclura rileyi rileyi*) are quite territorial. Here a larger lizard evicts a smaller individual from a prime basking site.

ROBERT POWELL

These San Salvador Rock Iguanas (*Cyclura rileyi rileyi*), both from Green Cay, show striking differences in condition. The individual in the upper photograph is healthy (at least partially the result of supplemental feeding by tourists), whereas the individual in the lower photograph is emaciated, testament to the food-limited realities of small cays, which are exacerbated during droughts.



In an effort to reduce unnecessary interactions and promote conservation, the IRCF has provided signs in English and French (for patrons of Club Med).

Iguanas bask on rock outcroppings and seek shelter in rock crevices and patches of Sea Grape (*Coccoloba uvifera*) and other vegetation, but require sandy areas for nest construction (Hayes 2000, Hayes et al. 2004). They also exploit sand strand with Sea Oats (*Uniola paniculata*), Buttonwood (*Conocarpus erectus*), and other mangroves, as well as other coastal coppice plant species. Iguanas are sometimes found in trees (Paulson 1966); however, most foraging and other activities occur on the ground. Although they occasionally consume or scavenge birds, land crabs, and insects (Hayes et al. 2004), iguanas are almost entirely herbivorous, often distributing seeds in their feces, which also facilitates germination and enhances the viability of the seeds and seedlings. One principal source of food is the Prickly-pear Cactus (*Opuntia stricta*), which has been severely degraded by the invasive Cactus Moth (*Cactoblastis cactorum*) (Hayes et al. 2004). On Green Cay, iguanas have become accustomed to human visitors and will flock to meet them, expecting to be fed.

Adult males are territorial throughout the year and perform displays that include head-bobs and push-ups when approached by an intruder or to attract a female (Hayes 2000). Courtship and mating occur in late May and June followed by nesting and egg laying in July. Most females actively defend nest sites, which can be used repeatedly in subsequent nesting seasons. Clutch size is related to female size, and while one clutch of 10 eggs has been recorded, most clutches contain 3–6 eggs (Hayes 2000, Hayes et al. 2004).

In addition to feral mammals and vehicles on San Salvador proper, rising sea levels threaten to inundate the low-lying cays, and diseases could be catastrophic because of small population sizes and lack of genetic diversity. Despite strict protection by international (CITES Appendix I) and Bahamian laws, humans illegally remove iguanas for food or to supply the trade in live animals. *Cyclura rileyi* (all three subspecies) is listed as Endangered on the IUCN Red List.

Brown Anole (*Anolis sagrei ordinatus*)

Anolis sagrei ordinatus is widely distributed throughout the Bahamas, and *A. s. sagrei* is found across Cuba. Introduced populations are known from Jamaica, the Cayman Islands, several of the Lesser Antilles, the Atlantic coast of Mexico and Belize, and Florida (Powell et al. 2011).

Considered a "trunk-ground" ecomorph (Rand and Williams 1969), these anoles tend to perch low on tree trunks and other vertical structures, often assuming a "watch" position with head down and elevated to scan the area below the perch for prey (Schoener 1979). They occur in a variety of sunny habitats, including savannas, open forests, and coastal habitats, but rarely in dense forests, where they are largely restricted to openings (Henderson and Powell 2009). Populations often are densest in areas of intermediate insolation. Ecologically versatile (e.g., Oliver 1948), they readily inhabit altered habitats, where they can be quite abundant in edificarian situations such as yards and patios, where individuals can be encountered on the ground, in brush, and on fallen logs and boards, fences, and piles of debris and rocks. On San Salvador, *A. sagrei* is most likely to be encountered in open areas, where it is essentially ubiquitous and tends to perch lower than sympatric *A. distichus* (unpubl. data). It also occurs on some of the offshore cays.


ROBERT POWELL

Brown Anoles (*Anolis sagrei ordinatus*), especially adult males, often assume a "watch" position with head down and elevated to scan the area below the perch for prey.

ROBERT POWELL

Male Brown Anoles are intensely territorial. This individual is displaying to "protect" his territory on a discarded washing machine.

Anolis sagrei has long toes and reduced toe pads, which facilitate running and jumping rather than climbing (e.g., Losos 2009). Males on Cuba reach a SVL of 70 mm (Schwartz and Henderson 1991) and females 47.8 mm (Rodríguez Schettino 1999), but most individuals on San Salvador are smaller. Ground color varies from light gray to brown to almost black with patches, spots, and chevrons on females and young males, but lacking in adult males.

GUILLERMO G. ZUNIGA

PAUL A. HILLBRAND

We found multiple females, two intact eggs, shells of at least seven hatched eggs, and a recent hatchling in a pile of debris near the edge of a large concrete catch basin near the Gerace Research Centre, suggestive of communal nesting in Brown Anoles.

ROBERT POWELL

WILLIAM K. HAYES

Female Brown Anoles (*Anolis sagrei ordinatus*) retain a juvenile pattern that might be comprised of a middorsal stripe or a series of spots or rhomboid shapes.

Like most anoles, Brown Anoles tend to feed on insects and other small arthropods, although they are known to eat smaller lizards, including juvenile conspecifics (Henderson and Powell 2009). Generally diurnal, lizards on San Salvador are known to exploit the "night-light niche," feeding on nocturnal insects attracted to artificial lights at night (R. Powell, unpubl. data).

In typical anoline fashion, *A. sagrei* engages in social behaviors that include head-bobs, push-ups, vertical tail wags, and dewlap extensions. Males are aggressively territorial and often become very dark (even black) when facing off or fighting an intruder (Schwartz and Henderson 1991).

ROBERT POWELL

Together, Green (where this photograph was taken) and Goulding cays support more than two-thirds of the entire world's population of San Salvador Rock Iguanas (*Cyclura rileyi rileyi*).

San Salvador's Amphibians

Two native frogs occur on San Salvador, but are limited by the harsh xeric conditions and near absence of fresh surface water, which are not conducive to an amphibian lifestyle. Although the Bahamian Flathead Frog (*Eleutherodactylus rogersi*) has no free tadpole stage (tadpoles develop in the egg and hatch as tiny froglets), moist conditions are essential for the survival of the eggs. The Cuban Treefrog (*Osteopilus septentrionalis*) does require fresh surface water for breeding, and has undoubtedly benefited from artificial "ponds" such as cisterns and catch basins.

WILLIAM K. HAYES

Bahamian Flathead Frogs (*Eleutherodactylus rogersi*) are rarely encountered outside the rainy season.

WILLIAM K. HAYES

Cuban Treefrogs (*Osteopilus septentrionalis*) begin calling with the first showers of the rainy season. They spend the dry season deep in moisture-retaining crevices under the bark of trees, buildings, or piles of debris.

HAYS CUMMINS, MIAMI UNIVERSITY

Green Herons (*Butorides virescens*) have quickly adapted to prey made available by humans. This heron is eating a Cuban Treefrog tadpole in the waters of the catch basin near the Gerace Research Centre. We also observed a Green Heron stalking and eating Brown Anoles.

Reproduction in most populations appears to coincide with the rainy season (June–October; Henderson and Powell 2009), but little is known about populations on San Salvador, where we discovered evidence of communal nesting in June 2011.

Bark Anole (*Anolis distichus ocior*)

Anolis distichus, with 17 currently recognized subspecies, occurs on Hispaniola and the Bahamas (Powell and Henderson 2009), and at least two subspecies have been introduced in southeastern Florida. *Anolis d. ocior* is endemic to San Salvador and Rum Cay in the Bahamas.

Bark Anoles live primarily in forested areas, but also occur along coastal zones, in scrub savannas, and in human-modified habitats, including on and in houses (Schwartz and Henderson 1991). On San Salvador, they are locally abundant, but missing from many areas that lack large trees and deep shade. They also occur on several offshore cays. Bark Anoles are "trunk" ecomorphs (Rand and Williams 1969), and generally perch on tree trunks or analogues such as fence posts or telephone poles, on which they feed primarily on ants. They also will consume other insects and small arthropods. They "restlessly" search and then passively wait in front of an ant trail to "gobble" up unsuspecting prey with a quick flick of the tongue (Schoener 1968, 1979; Schoener and Schoener 1980).

Anolis distichus is comparable in size to the Brown Anole, with males attaining a maximum SVL of 58.4 mm and females 50.2 mm on Bimini and the Andros Islands (Schoener 1988). These anoles have a smooth, even coloration ranging from gray to brown to light green to yellow, and lack the distinct chevrons or blotches of *A. sagrei*. The venter is usually dull white. Males tend to be more richly colored than females.

GUILLERMO G. ZUNIGA

Bark Anoles (*Anolis distichus*) occur on Hispaniola as well as in the Bahamas. Almost certainly a complex of species, dewlap and ground colors vary considerably. The dewlap of this displaying male *A. d. ocior* is typical of individuals on San Salvador.

ABBY TATE

San Salvador Curlytails (*Leiocephalus loxogrammus parnelli*) are most abundant in open scrub or rocky habitats.

Bark Anoles are very restless in nature, rarely remaining in one spot for more than a few minutes. When approached, these anoles "squirrel" to the opposite side of the perch before moving up or down to avoid a threat. Often most active in early morning and late evening, these lizards seek shade during the heat of the day. Like other anoles, territorial and mating displays include head-bobs, push-ups, and dewlap extensions.

San Salvador Curlytail (*Leiocephalus loxogrammus parnelli*)

Leiocephalus loxogrammus parnelli is endemic to San Salvador, and the only other subspecies occurs on Rum Cay, although a population not assigned to either subspecies apparently occurs on Conception Island (Schwartz and Henderson 1991). These lizards are found along edges of large open areas, particularly rocky sites, but also on sandy beaches and more densely vegetated coastal habitats and in human settlements. They are less abundant in scrub and shrub habitats (Schwartz and Henderson 1991). They are frequently encountered around some of the ruins dating back to the loyalist era. Small populations exist on Catto and High cays.

Albeit far more terrestrial (lizards in the genus *Leiocephalus* rarely climb into trees), they are, like anoles, primarily ambush predators, feeding largely on insects and other small arthropods, although they will take smaller lizards (Schoener et al. 1982). Facultatively and seasonally omnivorous, they also eat buds, flowers, seeds, and small fruits.

San Salvador Curlytails are of moderate size, with males reaching a SVL of 90 mm and females 70 mm. They can be identified by black and white longitudinal stripes down the back and by their body shape. Ground

ROBERT POWELL

Despite the common name, not all "curlytails" curl their tails. This juvenile is curling its tail about as much as has been observed in lizards on San Salvador.

colors range from brown to gray. Males are often streaked with black diagonal lines, whereas females typically possess two cream-colored longitudinal stripes. The venter is gray, occasionally with a yellow-orange cast (sometimes bright).

Social behaviors involve head-bobs and push-ups, and threat displays might include gular inflation and elevation on all four limbs. As implied by the common name, Curlytail lizards are known for the ability to curl their tails and, in some species, the coiled tail rides over their backs like the tail of a scorpion — but the San Salvador Curlytail does not curl its tail. Mating is thought to coincide with the rainy season, when females lay eggs that need two months to hatch (Schwartz and Henderson 1991).

TIFFANY SCHULTHEIS

Although curlytails rarely climb, they will occasionally forage into low vegetation or climb onto elevated perches to escape predators.

Tropical House Gecko (*Hemidactylus mabouia*)

This non-native species was first seen in San Salvador in 1998. Native to Africa, now widely distributed in South America and the greater Caribbean, the species has been introduced in southern Florida (Powell et al. 1998). The adhesive and water resistant eggs of *H. mabouia* can stick to cargo of various types, which facilitates this species' expansion to new parts of the world (Gibbons 1985), but most West Indian introductions are almost certainly attributable to "hitch-hiking" with goods (especially ornamental plants) and containers (Kraus 2009, Powell et al. 2011).

Ground color usually is pale gray or tan, although this can vary considerably based on the location and condition of an individual. Similarly, a pattern of dark chevrons ranges from quite distinct to virtually absent. Males reach a SVL of 68 mm (Schwartz and Henderson 1991), females 61 mm (Howard et al. 2001).

In the Western Hemisphere, these nocturnal geckos are almost exclusively synanthropic commensals (Henderson and Powell 2009), and are typically found around buildings and on walls, where they are frequently observed foraging for insects attracted to artificial lights (Perry et al. 2008,

ROBERT POWELL

Introduced Tropical House Geckos (*Hemidactylus mabouia*) are closely associated with human habitations and frequently forage around artificial lights at night.

WILLIAM K. HAYES

Although almost exclusively synanthropic commensals, Tropical House Geckos occasionally exploit natural habitats such as trees and limestone outcroppings near the shore.

Powell and Henderson 2008). On San Salvador, they are encountered in those and other urban situations, sometimes under loose bark, or even under rocks that by day are exposed to direct sunlight (unpubl. data).

Their adhesive feet allow them to scale walls and hang from ceilings to catch prey. These geckos are wary and easily frightened and emit squeaks when captured or fighting (e.g., Bartlett and Bartlett 1999). In Florida, Tropical House Geckos breed throughout the year. Eggs are laid singly or in pairs under rocks, leaf litter, or in various crevices, and communal nesting has been observed (Krysko et al. 2003, Henderson and Powell 2009).

San Salvador Dwarf Gecko (*Sphaerodactylus corticola soter*)

Sphaerodactylus corticola occurs only in the Bahamas; *S. c. soter* is endemic to San Salvador, where it is known from many offshore cays as well as islets in the inland lakes. Often associated with human settlements or debris (Schwartz and Henderson 1991), these geckos also are found under palm fronds, boards, logs, small rocks, and in piles of natural and human trash (Schwartz 1968) or even in iguana burrows (Gicca 1980).

These diminutive lizards (male SVL to 37 mm, females to 39 mm; Schwartz 1968) have short legs, thick tails, and pointed snouts. Ground color is pale to medium brown, and the pattern varies from almost uniform to small flecks and dots. Occasional females have vague, pale dorsolateral lines that are remnants of the juvenile pattern. The skin is soft and velvet-like.

San Salvador Dwarf Geckos are primarily nocturnal; they hide by day beneath cover and emerge at dusk to feed on small insects. On San Salvador, they often enter buildings but rarely crawl on walls, remaining on or close to the ground. They mate from June to December; clutches of single eggs, sometimes deposited communally, are laid in leaf litter or crevices under loose bark, and hatchlings have a SVL of 16–17 mm (Schwartz 1968, Schwartz and Henderson 1991).

San Salvador Threadsnake (*Epictia columbi*)

Threadsnakes occur in both the Eastern and Western hemispheres, but this species (formerly *Leptotyphlops columbi*; Adalsteinsson et al. 2009) is endemic to San Salvador, where it is the only snake known to occur on the island. This very secretive and seldom seen species is almost exclusively fossorial, but can be encountered when lifting surface cover (Riley 1981) or above ground shortly after heavy rains. They also are found in logs, and are known locally as "wood worms" (Schwartz and Henderson 1991).

The occurrence of threadsnakes on this one island in the Bahamas, and on several other isolated islands in the West Indies that have never been connected to continents, suggests they are capable of dispersal over ocean waters, presumably on rafts of vegetation or volcanic pumice, or within floating logs (Adalsteinsson et al. 2009). The San Salvador Threadsnake has been documented on Gaulin Cay (Riley 1981) and Low Cay (Dave Manary, pers. comm.), so it probably occurs on most offshore cays.

WILLIAM K. HAYES

San Salvador Dwarf Geckos (*Sphaerodactylus corticola soter*) often enter buildings but rarely crawl on walls, remaining on or close to the ground.

ROY TOFT

San Salvador Threadsnakes (*Epictia columbi*) are very secretive and almost exclusively fossorial, but can be encountered when lifting surface cover or above ground shortly after heavy rains.

The San Salvador Threadsnake is very small and slender, superficially resembling an earthworm. The head and body are mostly very dark, almost black, and the venter is slightly lighter. Maximum SVL is 180 mm (Schwartz and Henderson 1991), with a very short tail (~13 mm).

Threadsnakes use their shovel-like mouth to scoop up ant larvae and pupae. The mouth and feeding mechanism (mandibular raking) appear to be adaptations for rapid feeding, which is needed when raiding ant nests due to vulnerability to ant attacks (Kley and Brainerd 1999). This gives the snake a chance to make a hasty exit. Fire Ants (*Solenopsis invicta*) from South America have become established on San Salvador (Davis et al. 2001), and these aggressive predators with powerful stings could threaten the San Salvador Threadsnakes as well as the other small reptiles on the island.

Acknowledgments

We thank the staff of the Gerace Research Centre for their tolerance and encouragement, and Drs. David Wissmann and Robert Powell for providing the opportunity for PAH and ATS to visit and explore San Salvador.

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JOSEPH BURGESS

A Western Giant Anole (*Anolis luteogularis*) in the Viñales Valley in Pinar del Río Province.

TRAVELOGUE

Revisiting the "Real" Cuba

Tandora Grant

Research Coordinator, Applied Animal Ecology Division, San Diego Zoo Institute for Conservation Research

During the relaxation period at the end of class, my favorite yoga teacher tells her students to "take a moment to acknowledge all the blessings in your lives." To that I add, "and be grateful for all the cool experiences!" I feel very fortunate to have had the recent opportunity to return to the "real" Cuba for the 14th annual Iguana Specialist Group (ISG) meeting in Cuba in November 2010.

As part of my work in iguana conservation at the San Diego Zoo Institute for Conservation Research, I had worked on the military base at Guantánamo Bay more than a dozen times during as many trips before being invited to participate in a Population Habitat and Viability Analysis (PHVA) workshop for the Cuban Iguana (*Cyclura nubila*) in January 2003. This meeting was hosted by the Havana Zoo (Jardín Zoo de La Habana) and the Conservation Breeding Specialist Group (CBSG) and brought together iguana and conservation specialists from throughout Cuba and a few from abroad. As an invited guest to a scientific meeting, I was legally permitted by the United States government to visit Cuba, although in those days the U.S. trade embargo was very strict and restrictive. Cuba's economy was tightly controlled and the separation between currency for Cuban nationals and that which foreigners could use was well defined. We could eat only in specific restaurants and opportunities to buy souvenirs were almost non-existent. Even the famous ice cream park, Coppelia, had a very sedate indoor cafe for tourists only, in contrast to the large, bustling and vibrant local side. Thankfully, my two colleagues from the CBSG and I were escorted to see numerous sights within Habana Vieja (Old Havana) by our hosts from the zoo. It was a very brief but wonderful trip that left me wanting to return.

This time my trip included a little more time in Havana and a journey to the far western-most point for the meeting site. Travel restrictions for

ALLISON ALBERTS

Castillo de los Tres Reyes del Morro, the fort and lighthouse at the entrance to the Havana harbor.

TANDORA GRANT

Old U.S. and Russian-made cars at the harbor parking lot in Habana Vieja. Graffiti-styled paintings of Cuban heroes, like this one of Che, are common on public buildings.

JEAN-PIERRE MONTAGNE

The Catholic cathedral in old Havana (Habana Vieja).

MACHEL EMANUEL

1960 Chevrolet Impala in Habana Vieja.

U.S. citizens have eased somewhat for people with relatives in Cuba, and direct flights from Miami to Havana are now available. Still, the logistics of organizing travel clearance for a delegation of 50 people were migraine-headache worthy. We are very grateful to ISG member Joe Burgess and Luis Díaz Beltrán (Curator of Herpetology at the Museo Nacional de Historia Natural) and his wife Arianna, who is a "nature tourism specialist" with Cubatur, for making our trip possible. When we arrived in Havana, everyone immediately started photographing the 1950s-era American-made cars in the airport parking lot. This was the first of many signs that life in Cuba is radically different from other Caribbean islands and its neighbor to the north a mere 90 miles away.

TANDORA GRANT

Public mosaic art in a section of the community park near José Marti Stadium, Habana Vieja.

JOSEPH BURGESS

The seat of the government before The Revolución, the Capitolio Nacional Cuba on the edge of Habana Vieja, is now home to the Ministries of Science, Technology, and Environment.

A first-day, five-hour bus and walking tour of the capital city focused mostly on Habana Vieja. Among the highlights, the group saw the capitol, the cathedral, the Granma Memorial, the Museo de la Revolución, the Malecón, and famous haunts of Ernest Hemingway; they also toured the rum museum and had a traditional meal at the El Patio restaurant. The buildings in the Vieja area are almost entirely Spanish colonial and neoclassical architecture, and many of them have been restored to their original grandeur. Sadly, buildings in need of serious repairs are equally common. Since my previous trip, I had the impression that the number of bars, restaurants, and patio cafes had increased exponentially — and all were open and filled with Cubans, foreign workers, and tourists alike. Little alcoves offered souvenirs and crafts for sale, and artists were busily painting. As before, however, music and singing filled the streets, emanating from the restaurant/bars or from little groups of friends harmonizing together.

Since I had been to Havana previously and knew there would be more time at the end of the week for sight-seeing, I opted to spend the afternoon with my fellow San Diego Zoo colleague, Jean-Pierre Montagne, whose mother's family is from Cuba and who had arranged to visit with friends of relatives. Our hotel was in the Miramar suburb, across the street from the giant obelisk-shaped Russian embassy. This area is the center for foreign embassies and businesses; the houses are noticeably larger and more affluent, and the cars are more modern and European. Our first stop was for lunch at nearby El Aljibe, an open-walled thatched-roof restaurant where I had been before. I knew to forgo the menu and order the roast chicken special that comes with loads of traditional sides, like plantains, rice and black beans, fried potatoes, and salad. Of course, we also enjoyed our first (and arguably the best) of many Mojitos during the trip. We spent a lovely afternoon visiting with the childhood friend of Jean-Pierre's aunt — looking at old photographs and chatting about lost relatives, travel restrictions, a recent performance by the American Ballet Theater, and plants in her garden. As I noticed throughout Cuba, her home is modest compared to the U.S. average, but exquisitely clean and tidy. She was an absolutely charming hostess. Later, we wandered the nighttime streets and plazas of Habana Vieja, attracted to several happening spots by the infectious music from live bands. All our pictures that night are blurry because capturing moving musicians while your hips are swaying and toes are tapping was simply impossible!

The next day, we boarded a coach for the journey to the Guanahacabibes Peninsula in Pinar del Río Province. The trip took almost the entire day. At first we traveled through mostly agrarian landscape and

EVERT HENNINGHEIM

Waves regularly crash over the breakwater along the Malecón, Habana Vieja.

EVERT HENNINGHEIM

Morning sun over the Miramar suburb of Havana.

JEAN-PIERRE MONTAGNE

"Pregnant palms" at our first roadside rest stop on the way from Havana to the northwestern coast. Many species of palms in Cuba are harvested for wood and thatch.

JEAN-PIERRE MONTAGNE

The only billboards in Cuba depict heroes and governmental ideals. "51 years of struggles and victories" refers to the time elapsed since the Cuban Revolution, and features Ernesto "Che" Guevara and Fidel Castro.

small towns. Glued to the bus window, I reflected on the many differences compared to other countries I have visited. A huge difference is the lack of product advertising so pervasive in most global cultures. The only "billboards" I saw were artistic paintings depicting heroes of the Revolution and "advertising" governmental ideals and slogans. In some ways, rural Cuba seems very modern, with every house connected to an electrical wire, and yet we passed fields being plowed by oxen. Horse-driven carts were common and appeared to serve as local buses. From my perspective of excessive abundance, Cuba is poor, but the poverty has a different face — no signs of malnutrition, and everyone has clean and well-kept clothes. Above all, absolutely no trash litters the roadsides or towns.

JEAN-PIERRE MONTAGNE

Horse-drawn carts are common, and often used for public transportation in this town on the way to the western coast.

MICHAEL FOURAKER

Agricultural fields along the route from Havana to Guanahacabibes are plowed with teams of oxen.

After several hours, the road became narrow and winding as we passed through an area dominated by inland limestone hills and cliffs full of caves and sharp edges. I daydreamed about rock climbing and finding snakes and frogs among the "diente de perro" (dog's tooth) karst of the Guaniguanico Mountain Range. When we finally arrived at the western end of the island and literally the end of the road — Maria la Gorda, a diving and nature-focused hotel on the white sand beach of Bahia de Corrientes and miles from any other habitation, we were welcomed by fellow iguana biologists and conservationists from other parts of Cuba. I was disappointed to hear that Vincente Berovides from the Universidad de la Habana, whom I had met previously at the Cuban Iguana PHVA, was not going to be able to join us. However, I was delighted to finally meet Orlando Garrido from the Museo Nacional de Historia Natural, whose many manuscripts on Cuban herpetology and avifauna I had read (he also was a former tennis pro!). We learned he is currently writing a reference on Cuban fish that will include photographs. Throughout the week, we were thoroughly charmed by his animated anecdotes.

Our meetings were held at the visitor center and headquarters for the Guanahacabibes National Park. The park includes most of the peninsula and comprises 23,880 ha of land and 15,950 ha of sea. The area is home to 704 plant, 16 amphibian, 35 reptilian, 192 avian, and 18 mammalian spe-

cies, many of which are locally endemic. The United Nations has included this region in its World Network of Biosphere Reserves and it is of major economic importance as a spawning site for fish and invertebrates in the Caribbean. We had nearly three full days of presentations and discussions, with updates on iguana projects in the Greater and Lesser Antilles, Central America, Fiji, and Cuba. I was particularly interested in the eight talks presented by our Cuban colleagues, since so much had been accomplished toward monitoring and mapping the distribution and abundance of iguanas throughout Cuba — exactly what the PHVA group had determined was needed! A few studies also have been conducted on diet, morphological variation, reproduction, genetics, threats, and human use and attitudes. As is true for most Cuban herpetofauna, the biggest threat to iguanas is habitat alteration and fragmentation.

MIGUEL GARCIA

The author talks to the Cuban herpetological and ornithological hero, Orlando Garrido.

STEVE CONNERS

One of two species of *Amphisbaena* found in Cuba, this captive Cuban Spotted Amphisbaena (*Cadea blanoides*) was shown to us by Luis Díaz, Curator of Herpetology at the National Museum of Natural History.

JOSEPH BURGESS

Cuban Treefrog (*Osteopilus septentrionalis*) on the Guanahacabibes Peninsula.

CAROLINE LEGOUEZ

Field trip to the rocky limestone cliff habitat along the western coast of the Guanahacabibes Peninsula where iguanas were the most abundant.

JEAN-PIERRE MONTAGNE

Sunset view at Maria la Gorda, a hotel specializing in scuba diving in the marine protected area of Parque Nacional, Guanahacabibes Peninsula.

Cuba has a National System of Protected Areas (SNAP) that includes 253 sites and represents nearly 20% of the country, including areas of the sea shelf to depths of 200 m. Its mission is to protect biological diversity and promote sustainable development. Protected areas vary with respect to their legal status, administrative and authoritative structure, and conservation value. For example, management plans for an Ecological Reserve will be very different from that of a Managed Resource Protected Area. Proposals for new protected areas begin with approval at the local level and move up to the main national council. The first national park was established in Holguín Province in 1930, and the most recent, declared just this year, will include the highest peak in the central Guamuhaya Mountains. Only a few species of Cuba's reptiles and amphibians are not currently found in these protected areas, and efforts to include them in an ever-expanding network are ongoing.

In the evenings, most of our group went "herping by headlamp," either by themselves or in small groups led by Luis Díaz. I was happy to see a Cuban Treefrog (*Osteopilus septentrionalis*), not my first, since they are invasive to many places now, but finally somewhere it is supposed to be! This feeling was not quite as intense as my joy at finding Cane Toads (*Rhinella marina*) in the Amazon and for once being able to appreciate their existence rather than cringing at their presence! We also enjoyed a day-long field trip exploring the entire length of the bay through the forest and along the open rocky coast at the western-most point of Cuba. In the cliff zone, we had our best views of Cuban Iguanas, which were quite cryptic and shy. We also saw first-hand the consequences of recent road widening for the development of tourism. We learned that iguana density in this zone had been reduced from 17.2 to 4.0 iguanas/ha during construction of the road. Guanahacabibes park staff is working on an educational program for tourists and local residents to reduce the incidence of vehicular casualties.

ALLISON ALBERTS

Male Cuban Iguana (*Cyclura nubila*) on the open rocky coast of the northwestern Guanahacabibes Peninsula.

JEAN-PIERRE MONTAGNE

Forest death on the Guanahacabibes Peninsula after Hurricane Ivan where a former freshwater depression became saline.

JEAN-PIERRE MONTAGNE

We found desiccated Cuban Iguana (*Cyclura nubila*) carcasses alongside the road on the Guanahacabibes Peninsula; their deaths were most likely attributable to automobiles.

JEAN-PIERRE MONTAGNE

The rocky coastline at the western-most point of Cuba, the Guanahacabibes Peninsula. Even remote areas are not immune to flotsam trash washed ashore.

JEAN-PIERRE MONTAGNE

Blooming *Plumeria* found in the rocky limestone cliff habitat along the western coast of the Guanahacabibes Peninsula where iguanas were the most abundant.


MIGUEL GARCÍA

Allison Alberts, the author, Orlando Garrido, Cielo Figuerola, and Bonnie Raphael (holding Orlando's field guide to the birds of the West Indies).

Toward the tip of the peninsula, we stopped at a depression where all the trees had died after Hurricane Ivan in 2004. This was an area that used to collect fresh water during seasonal rainfall, but the hurricane had substantially altered the land such that it now connects to the saline ocean and is toxic to those trees. At a nearby pond, we also had far-away views of an American Crocodile (*Crocodylus acutus*) and Cuban Slider (*Trachemys decussata*), which is the only freshwater turtle in Cuba. Thanks to Orlando and his field guide, we identified some great birds. These included the Red-legged Thrush (*Turdus plumbeus*), Black-throated Blue Warbler


JOSEPH BURGESS

Cuban Trogon (*Priotelus temnurus*) on the Guanahacabibes Peninsula.

Species Encountered During the Trip

Joseph Burgess

Lizards

Cuban Ameiva (*Ameiva auberi*)
Spanish Flag Anole (*Anolis allogus*)
Cuban Twig Anole (*Anolis angusticeps*)
Pinar del Rio Cliff Anole (*Anolis bartschi*)
Cuban Giant Anole (*Anolis equestris*)
Cuban White-fanned Anole (*Anolis homolechis*)
Western Giant Anole (*Anolis luteogularis*)
Red-fanned Rock Anole (*Anolis mestrei*)
Cuban Green Anole (*Anolis porcatus*)
Cuban Eyespot Anole (*Anolis quadriocellifer*)
Cuban Brown Anole (*Anolis sagrei*)
Cuban Stream Anole (*Anolis vermiculatus*)
Cuban Spotted Amphisbaena (*Cadea blanoides*) (captive individual)
Cuban Iguana (*Cyclura nubila*)
House Gecko (*Hemidactylus* sp.)
Saw-scaled Curlytail (*Leiocephalus carinatus*)
Cuban Striped Curlytail (*Leiocephalus stictigaster*)
Ashy Sphaero (*Sphaerodactylus elegans*)
Brown-speckled Sphaero (*Sphaerodactylus notatus*)
Cuban Giant Gecko (*Tarentola americana*)

Snakes

Cuban Racer (*Cubophis cantherigerus*)
Cuban Boa (*Epicrates angulifer*)
Giant Trope (*Tropidophis melanurus*)

Turtles

Cuban Slider (*Trachemys decussata*)

Crocodiles

American Crocodile (*Crocodylus acutus*)

Frogs & Toads

Cuban Groin-spot Frog (*Eleutherodactylus atkinsi*)
Guanahacabibes Frog (*Eleutherodactylus guanahacabibes*)
Cuban Treefrog (*Osteopilus septentrionalis*)
Western Giant Toad (*Peltophryne fustiger*)


JOSEPH BURGESS

Cuban Racer (*Cubophis cantherigerus*) on the Guanahacabibes Peninsula.

(*Dendroica caerulescens*), Loggerhead Kingbird (*Tyrannus caudifasciatus*), Cuban Trogon (*Priotelus temnurus*), Cuban Grassquit (*Tiaris canora*), and a juvenile Cuban Black Hawk (*Buteogallus gundlachii*). I particularly enjoyed listening to the calls of Cuban Crows (*Corvus nasicus*) that sound something like giggling turkeys.

On our last day at Guanahacabibes, I was delighted to have time to work with Cuban biologists to collect more information on current iguana research. One of my latest projects for the Iguana Specialist Group is to coordinate the creation or revision of Red List Assessments for all species in the family Iguanidae. The IUCN Red List is the world's most comprehensive and objective database on biodiversity, and it plays a prominent role in guiding conservation activities for governments and scientists. In addition to the text that is viewable on the Red List website (www.iucnredlist.org), considerable data are recorded on each species' natural history, habitat, threats, and research and conservation actions. When the last assessment for *Cyclura nubila* was written, very little was known about its distribution, and most of that was inferred from our knowledge of the population at Guantánamo Bay. Being a data geek, I was thrilled to absorb the new information from the rest of the island. Having just been through the Mona Island Iguana assessment the previous night, I was very grateful for assis-

JOSEPH BURGESS

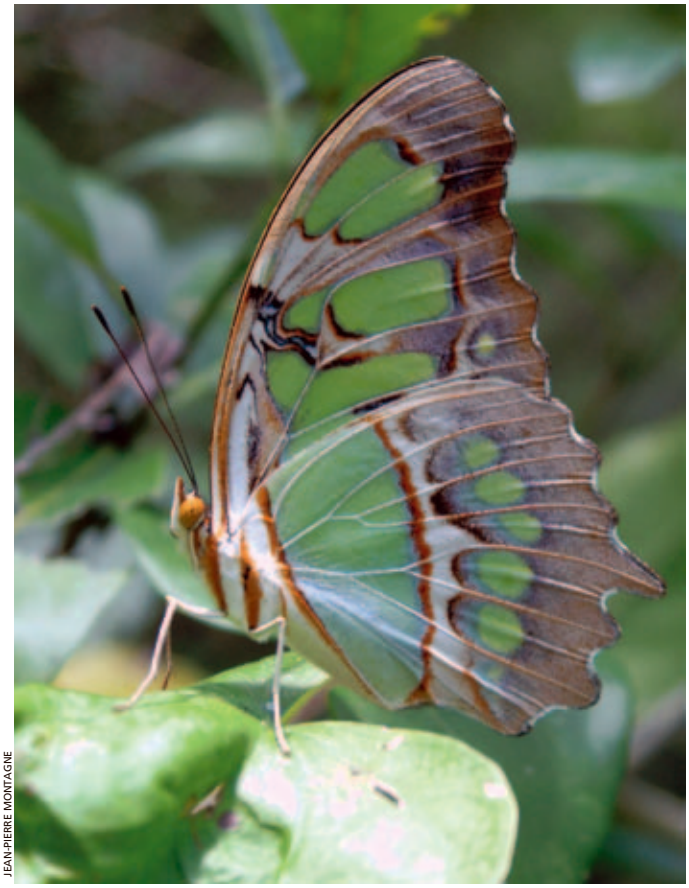
Cuban Racer (*Cubophis cantherigerus*) eating a Cuban Treefrog (*Osteopilus septentrionalis*), Guanahacabibes Peninsula.

ALLISON ALBERTS

Sub-group workshop to revise the IUCN Red List assessment of the Cuban Iguana.

IAN RECCHIO

Ashy Sphaero *(Sphaerodactylus elegans)* on the Guanahacabibes Peninsula.



JEAN-PIERRE MONTAGNE

An unknown species of butterfly on the Guanahacabibes Peninsula.

JEAN-PIERRE MONTAGNE

A juvenile endemic Cuban Black Hawk (*Buteogallus gundlachii*) on the Guanahacabibes Peninsula.

JEAN-PIERRE MONTAGNE

Limestone cliff/hills (mogotes) characterize the landscape of the Viñales Valley in north-central Pinar del Rio Province. Turkey Vultures (*Cathartes aura*) are visible in the foreground.

tance from Miguel Garcia and Cielo Figuerola, who served as interpreters during the evaluation for *C. nubila*.

We took a slightly different route on the return trip back to Havana through the Viñales Valley. The little teaser of limestone hills we saw previously was small potatoes compared to the beauty of this national park! We stopped for a fabulous banquet lunch at an area where you could also tour part of the cave system by boat. Around the outsides of the caves, most of

JOSEPH BURGESS

Cuban Fruit-eating Bat (*Brachyphylla nana*) in the Viñales Valley, Pinar del Río Province.

JOSEPH BURGESS

Pinar del Rio Cliff Anole (*Anolis bartschi*) in the Viñales Valley, Pinar del Río Province.

JOSEPH BURGESS

Cuban Stream Anole (*Anolis vermiculatus*) in the Viñales Valley, Pinar del Río Province.

us saw *Anolis vermiculatus* and *A. bartschi*, two amazing anoles endemic to this region.

Our last morning in Havana was spent either sightseeing or touring the larger of Havana's two zoos, Parque Zoologico Nacional de Cuba. We learned about successful captive breeding for a very few of the Cuban reptiles — but no amphibians. Chytrid fungus has recently been discovered on the Cuban Long-nosed Toad (*Peltophryne longinasus*), and funds to develop an *ex situ* captive-breeding program and further monitoring of wild species have recently been obtained from the Amphibian Ark. For those of us working with captive programs, we hope that this meeting was a "door opener" for future collaborations where our experience can be of value.

Sixty-two species of amphibians (95% endemic) and 166 species of reptiles (83% endemic) are known to occur in Cuba. With just a few short days, we barely managed to scratch the surface of our Cuban life lists. Much of Cuba remains to be seen, and I for one cannot wait to return!

Acknowledgements

Details in this travelogue were gleaned from presentations by Amnerys González Rossell, Luis M. Díaz Beltrán, Dorka Cobián Rojas, José Luis Collazo Lopez, Lázaro Marquez Llauger, and Manuel Alonso Tabet. Special thanks to Jose Luis Polo Leal and Raul Campos, our hosts at the Parque Zoologico Nacional de Cuba.

Blunt-headed Treesnakes (*Uromacer catesbyi*) are elegant anuran-killing machines. The other species in the genus (*U. frenatus* and *U. oxyrhynchus*) are lizard specialists.

TRAVELOGUE

Four Days and Five Nights in a Herpin' Heaven

Craig S. Berg

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Photographs by the author.

The island of Hispaniola, with Haiti to the west and the Dominican Republic to the east, is the second largest island in the Antilles. Seen from a plane, the boundary between the two countries is clearly evident; it is a border of stark contrasts, of Yin and Yang. Haiti's natural resources have been ravaged — but perhaps ravaged is too polite a word … raped being closer to the mark. Many species have succumbed to extinction and many others are rapidly being swept into the maelstrom that leads them down the same path. Few trees remain in Haiti and those that do, even those in National Parks, are being felled to produce charcoal, the dominant fuel used to cook meals. Haiti appears stark and brown. The Dominican Republic (DR), in comparison, seems like a verdant oasis. However, the DR is far from pristine. Hundreds of years of agriculture and trade with Europe, Africa, and elsewhere in the Western Hemisphere have had their effect upon both flora and fauna. Yet the DR retains most of its original herpetofauna. Hispaniola also has another axis, a biological axis running east and west. Hispaniola was formed by a collision of two old islands. Both islands were on separate evolutionary tracks for a considerable period — long enough to have produced suites of closely related species. When these ancient islands merged, some species were able to move freely through the varied habitats, whereas others were restricted to their ancient homelands by swathes of inhospitable habitat. Biologists often refer to these separate but related entities as the North and South paleoislands.

Having never ventured to the DR, the invitation to attend the IUCN/AmphibianArk Caribbean Amphibian Conservation Needs Assessment workshops set fire to my imagination. I had worked on several islands in the Caribbean but never on an island with more than 20 species of herps. Although the meetings were being held in the middle of the DR's capital, Santo Domingo, previous experiences in the Caribbean assured me that any patch of green was likely to yield a herp species or two that I had never encountered.

I arrived in Chicago ready to endure 12 hours of travel time for the promise of a night of frog hunting in Santo Domingo at the end of it. Unfortunately, an explosion at an American Airlines fuel dump in Miami got between my frogs and me and shut down all American flights into and out of the city. Twenty-eight hours and three airports later, I finally collapsed into a taxi and headed for the Hotel Santo Domingo, the site of the meetings. The heady heat and humidity of the Caribbean (and more than a few of the billboards) fostered visions of an ice-cold "Presidente," the national beer of the DR. Although I don't speak Spanish, I do know a bit of Portuguese, so I was able to hold a somewhat tortured conversation with the driver. As we were driving through the capital, he passed through the red-light district, where he assured me that he knew each of the rather attractive ladies and that they liked Americans. Having been forewarned about tropical diseases (by the nuns in my grade school), I declined the offer. Farther down the road, he pointed to a large, well-guarded building and told me that it was "el palacio del Presidente." I enthusiastically replied that I knew "Presidente" and that it was a "buena cerveza." "No! No! No la cerveza!" he replied. "That is the home of the Presidente." I responded, "Okay, I understand. Es lo cervecero (the brewmaster)." He sighed in frustration and slowly shook his head. I could read his thoughts: Another ugly (and stupid) American…

I hit the hotel lobby at 3:15 in the afternoon. Shortly thereafter, I was in my room, directed to a small refrigerator containing "refreshments." At last I was to meet "el Presidente" for the first but not last time this trip. I hummed "Hail to the Chief" as I rifled through my bags gathering the materials that I had prepared for the meeting that had already begun. A few minutes later, I walked in and was introduced to colleagues who where doing evaluations of the amphibian fauna of Hispaniola. Due to the sheer size of the task, the group had been split into two groups. One was working with the IUCN to evaluate the status of the amphibians for the IUCN Red List and the other was evaluating the conservation needs of each species. I sat quietly, absorbing the methodologies that were being used so that I would be able to contribute when it came time to assess the amphibians of the Lesser Antilles, where I have conducted most of my Caribbean studies. Shortly thereafter, the meeting adjourned, and I learned that a few fieldtrips had been set up as after-hours activities. I was invited to go along that evening to do some nocturnal herping on the grounds of the Parque Zoológico Nacional (ZooDom) — if I wasn't too tired. Although I could have slept,

Calls of eleutherodactylid frogs were curiously absent in Santo Domingo. The most commonly heard anurans in the city were Hispaniolan Laughing Treefrogs (*Osteopilus dominicensis*).

even after several strong Dominican coffees, no stimulant is more powerful than the opportunity to go herping on a "new" island.

ZooDom is a green "island" surrounded by Santo Domingo. In many ways, it reminded me of my workplace, the Milwaukee County Zoo. It was completed in the early 1970s, it is large (125 ha in the middle of a metropolis), and it presents its wildlife in naturalistic settings. It also provides an urban oasis for visitors and wildlife alike. During the daylight hours, children at the Milwaukee County Zoo chase chipmunks; at ZooDom, they chase ameivas. Kids will be kids. But at night, when the Zoo closes, other animals crawl out of their diurnal retreats and take over the grounds. These were the very creatures that we wanted to see.

We arrived shortly before dusk. Night falls heavily in the Caribbean, so we were quickly enveloped by darkness. Having been forewarned about tropical diseases (not just by nuns), I applied insect repellant. In a coincidence befitting the occasion, the first herp that I observed was a female *Osteopilus dominicensis* (Hispaniolan Laughing Treefrog). This frog is, without a doubt, the most commonly encountered anuran on the island, yet not a single one of them escaped being captured by my camera lens. Some people take pictures of their children, I take photos of herps … and spiders … and snails … and centipedes. You get the picture. *Osteopilus dominicensis* shares many of the characteristics of its close relative the Cuban Treefrog (*O. septentrionalis*); it is about the same size, highly tolerant of disturbed habitats, commonly found in urban areas breeding in artificial pools and fountains, and it is a treefrog that doesn't require trees. In short, it is a Cuban Treefrog wannabe. Given the opportunity, *O. dominicensis* could become as problematic as *O. septentrionalis* if it ever slipped its island's bounds.

I had made a list of herps that I was most likely to see, least likely to see, and would sell my first born into bondage to see. Our next two discoveries, predictably, fell into the first category. Anoles are most easily observed and captured at night. Typically, they bleach out and they "pop out" rather than blend into the surroundings that conceal them by day. This is especially true of the anoles that sleep in trees. They also sit very still for photographs — a definite plus. During the day, they flash their characteristic color patterns and display magnificent dewlaps; however, if one were to fill out an 24-hour ethogram, most of their time would be spent "bleached out" firmly gripping their nocturnal resting spot. So, photos taken during the night could be viewed as being more typical of the species — but I digress. The next two species that I added to my "life list" were *Anolis cybotes* (Large-headed Anole) and *A. distichus* (Bark Anole). Anoles have four basic escape methods that they utilize when disturbed: (1) Run up a tree; (2) move to the opposite side of their perch, thus keeping the perch between themselves and their pursuer; (3) immobilization, using cryptic coloration to blend into their surroundings; or (4) hit the ground and run for cover. *Anolis cybotes* is known as a trunk-ground anole. It hits the ground running and, true to form, that's where we caught it. *Anolis cybotes* is a large, aggressive, predatory anole, males attaining 77 mm SVL (Fitch 2003). It makes good use of its powerful jaws, consuming both invertebrates and small vertebrates (smaller anoles) alike. *Anolis distichus* (Hispaniolan Gracile Anole) by contrast is a small anole (SVL 58 mm) that spends much of its day evading *A. cybotes* while foraging on ants and aphids. The Bark Anole uses escape strategy 2 to evade predation by *A. cybotes.* Both of these species are found island-wide, often in association with one another.

Meandering along the ZooDom paths, our guides, Adrell Núñez, Miguel Landestoy, and an armed guard, were repeatedly halted by the flock of photographers getting just one more shot of almost every frog and large spider that we encountered. Suddenly, the word "snake" echoed through the night and, just as suddenly, the harried frogs and spiders where left in peace, possibly blinded by camera flashes, but in peace. Our first snake of the evening was a young adult Hispaniolan Boa, *Epicrates striatus. Epicrates striatus* is semi-arboreal, feeding on lizards as a juvenile, and on rodents and birds as an adult (Sajdak 2003). Both of the Hispaniolan Boas we encountered that night were young animals actively foraging in small trees.

Why the Hispaniolan Gracile Anole (*Anolis distichus*) also is known as the Bark Anole is clearly evident in this image. Both the location and color pattern are ideally suited for foraging on trunks of trees.

The predominant sounds of the ZooDom night were produced by insects, Hispaniolan Laughing Treefrogs, and Bullfrogs (*Lithobates ccatesbeianus*). Bullfrogs were likely introduced to the island as a food source (Powell et al. 1999, 2011). The calls of Bullfrogs emanated from a pond that also contained *Trachemys decorata* (Haitian Slider), a species endemic to Hispaniola and neighboring islands. *Trachemys stejnegeri* (Antillean Slider) also is found on the island, although it has a much wider distribution; it is native to the Bahamas and Puerto Rico, and has been introduced to other Caribbean islands (Powell et al. 2011). The presence of these two turtles makes Hispaniola the only West Indian island on which two native emydid turtles are known to occur (Seidel and Incháustegui 1984). A third slider, *Trachemys scripta*, the Red-eared Slider, also occurs on the island and is displayed at ZooDom. This species is introduced and presents a danger to the genetic integrity of the native species with which it hybridizes. Another introduced species, the Cane Toad (*Rhinella marina*) can also be observed hopping about the zoo grounds. The Bullfrog, Cane Toad, and Red-eared Slider are probably the most widely distributed, purposefully introduced herp species on the planet.

Adrell, Miguel, and, of course, the rifle-toting guard next led us off the paths most traveled and into the surrounding forest in hopes of locating one of the largest species of *Eleutherodactylus* I have ever seen, *Eleutherodactylus inoptatus* (Hispaniolan Giant Frog). Females (the larger of the sexes) attain a snout-vent-length of 88 mm. This was to be my first of many *Eleutherodactylus* encounters. If I did not know better, I would have sworn that this beast was a ranid. The Hispaniolan Giant Frog is widely distributed on the island and it can tolerate disturbed areas if they retain a degree of tree cover (Henderson and Powell 2009.) While a number of us were busy

The Hispaniolan Boa (*Epicrates striatus*) has been called the "world champion stinky snake." We must have been blessed, as the musk of our captured snakes probably only rated a 0.6 on the snake-musk stenchometer.

Having chased diminutive frogs in the genus *Eleutherodactylus* all across the Caribbean, I was hard-pressed to think of the Hispaniolan Giant Frog (*E. inoptatus*) as an *Eleutherodactylus*. It is HUGE (88 mm SVL), looks like a ranid, and barks like a dog (vocalization a low *ba wo-ow*).

Although this picture was staged (see text), this scenario is not unlikely, as *Anolis cybotes* frequently takes to the ground — where Hispaniolan Tropes (*Tropidophis haetianus*) forage for frogs and lizards.

I was unable to get close enough to Hispaniolan Stout Anoles (*Anolis cybotes*) for a close-up — except when they were engaged in behaviors that kept them otherwise occupied.

snapping photos of the *E. inoptatus*, we happened upon a young-of-the-year Hispaniolan Boa sporting its beautiful orange juvenile coloration.

As it was approaching midnight, we made our way back toward the entrance. In a gutter along the road, we came upon our second snake species of the evening, an adult *Tropidophis haitianus* (Hispaniolan Trope). Fifteen minutes of camera light flashes later, someone caught an *A. cybotes* and offered it to the boa. As this diminutive (500 mm SVL) ground-dweller feeds mainly on lizards (Schwartz and Henderson 1991), why not give it a shot? After a brief period of coaxing, it grabbed the lizard and engulfed it as if no one was watching (or photographing). Lesson learned: Never underestimate the power of instinct, or hunger.

An hour later, I was back in my room, once again, greeting the "Presidente." In the past two days, I had been able to catch only three hours of fitful sleep, but I couldn't help but spend another half hour reviewing the "captures" of my camera's lens.

As the meetings were going well and we had had a late night, no sessions were scheduled for the next morning. One group of snakes on both my "most likely to see" and "would sell my first born into bondage to see" lists are in the genus *Uromacer*. Sixto Incháustegui, one of the world's authorities on Hispaniolan herpetology, was attending the meetings and recommended looking for them near the river at the Jardin Botanico Nacional Dr. Rafael M. Moscoso (aka the National Botanical Gardens), located in Santo Domingo a few minutes by taxi from our hotel. So, at 10 am, Richard Gibson of the Chester Zoo in England, Kevin Johnson of the AmphibianArk, and I grabbed a taxi and headed off to the Botanical Gardens for a bit of diurnal herping.

The Jardin Botanico Nacional is huge, more than 200 ha. A former military installation, it was founded in 1976 and dedicated to Dr. Rafael Moscoso, a Dominican botanist who catalogued the flora of the island in 1943. The garden serves as a center for education and recreation

Our rented van was unable to haul us up the rutted roads to the nature trails at Ebano Verde. Here, botanist Joel Timyan investigates the flora along the roadway, while Rafael Joglar and our guides from ZooDom continue the climb. The Mexican Umbrella Fern (*Gleichenia bifida*), which is native to Hispaniola, forms dense stands in disturbed cloud forests, often at the expense of other native plants — as is evident along the roadsides in this photograph.

As the sun set and the temperatures dropped at Ebano Verde, the respiration of the montane forest became tangible as a mist that slowly ascended the mountainsides.

ROY TOFT

Although this lizard looks like a skink and acts like a skink, it is actually a Hispaniolan Keeled Galliwasp (*Celestus stenurus*). Ten species of *Celestus* are currently recognized on Hispaniola, but *C. stenurus* is the only species known to occur in Santo Domingo.

with numerous trails and roadways along which to search for herps or view plants, if one is so inclined. Of course, we were there for the herps. Although we did not see a *Uromacer*, we were able to observe and photograph *A. cybotes* and *A. distichus* engaging in diurnal activities. We also encountered a third species of anole, *A. chlorocyanus* (Northern Green Anole). *Anolis chlorocyanus* is a good-sized anole, males reaching 79 mm SVL. They are a trunk-crown species (Rand and Williams 1969) and are highly territorial, with only one male in a tree (Rand 1962).

Richard Gibson was the lizard man on this outing. In a clump of agave, he spotted a *Sphaerodactylus* that unfortunately escaped before I was able to see it. In the same clump of agave, he was able to capture a Hispaniolan Keeled Galliwasp (*Celestus stenurus*). If you have ever tried to capture one of these slippery beasts, you know what an amazing feat this actually was. This diurnally active anguid is found throughout the island, and like all of the *Celestus* species is endemic to the island. By 3 pm, we were sun-baked and ready to return to our air-conditioned hotel to lie down for a few minutes before our evening's excursion to the Reserva Científica de Ébano Verde.

Anoles, such as this Northern Green Anole (*Anolis chlorocyanus*) were abundant in well manicured pockets of trees and shubs in the more formal parts of the Botanic Garden. This species (and *A. cybotes* and *A. distichus*) have established small colonies in Florida, where they were either knowingly or accidentally introduced.

This male Montane Bush Anole (*Anolis etheridgei*) was sleeping on a leaf, from which it would awaken and drop if a nocturnal predator (such as a boa) caused the branch to move.

Male and female Montane Bush Anoles (*Anolis etheridgei*) look very different, even at night. The female is so striking that my headlamp illuminated her 10 m away, yet a half dozen people walked right past without noticing her. While later sharing photos, several members of the party uttered: "How could I have missed that!"

I was able to get only two photos of a Tuck-wheep Frog (*Eleutherodactylus abbotti*) as, unlike most of the frogs that I encountered, this one quickly sought to escape from the light of my headlamp. The common name is quite descriptive of the call of these small frogs.

The Reserva Científica de Ébano Verde was created in 1989 to preserve the endangered native Green Ebony Tree (*ébano verde*). It is a 23-km^2 preserve located in the Cordillera Central in the Province of La Vega. La Loma la Golondrina, the preserve's highest point, reaches to 1,565 m. Ébano Verde is a froggy paradise. It was a long haul to the reserve, so we stopped along the way to refresh ourselves and stock up on local foodstuffs to serve as our evening repast. We reached the reserve shortly before nightfall and hiked up the mountain to enjoy the sunset. We took to the trail as the darkness grew and the frogs began to vocalize. That night I added an anole, the Montane Bush Anole (*A. etheridgei*) and three eleutherids to my tally, the Tuck-wheep Frog (*E. abbotti*), Hispaniolan Montane Frog (*E. montanus*), and the Hispaniolan Wheeping Frog (*E. minutus*). These are high-altitude endemics. The Hispaniolan Wheeping Frog was one of the species on my "least likely to see list" for three reasons: (1) It isn't in Santo Domingo (I never thought that we would be able to get out of the city), (2) it is one of the world's smallest frogs (19 mm SVL), and (3) it is endangered. When we were finally able to track down a vocalizing male, I was ecstatic! I had great concerns that I would be unable to get a decent photo of it while vocalizing. Fortunately, today's cameras are optical wonders, able to make a *montanus* out of a *minutus*. I was able to stand back and zoom in on the frog from a distance. With a little bit of enlargement, I was able to get a reasonably good photo. The night was long, but definitely a highlight of the trip.

The Hispaniolan Wheeping Frog (*Eleutherodactylus minutus*) is one of the world's smallest frogs (19 mm SVL). Like many of its brethren, the volume of its call belies its small size, compelling the listener to look for a much larger source.

On my last night in the DR, I had one last opportunity to see a *Uromacer*. The remnants of the workshop's participants were given the opportunity to return to the Botanic Gardens after nightfall. My hopes were high. While the green coloration of *Uromacer* makes it difficult to see during the day when it is active and foraging, during the night it perches in trees and its white belly seems to shine in the light of a headlamp. Others

From a mountain vantage point, one can easily determine that the Dominican Republic has an extensive agricultural infrastructure.

The most commonly seen of the rare eleutherodactylids at Ebano Verde (at least on this excursion) was *Eleutherodactylus montanus*. It was also the most beautiful.

We encountered a Dominican Giant Anole (*Anolis baleatus*) near the river in a forested area of the Botanic Garden.

on this excursion were Rafael Joglar, Luiz Díaz, Ariel Rodríguez, Alberto Estrada, and Richard Gibson. Most of the species we saw were animals that we had already seen on multiple occasions, O. *dominicensis, A. cybotes,* and *A. distichus*, but we did encounter the Hispaniolan Giant Anole (*A. baleatus*). Male *A. baleatus* may attain a SVL of 180 mm. The first male we found looked emaciated and wasted. Our guide reported that it had been a very dry dry-season. A second male appeared to be in much better shape.

My time was growing short. I was so focused on the trees above me looking for the telltale shining white venter of a *Uromacer* that I literally stepped over a large *E. striatus* that was on a path. I had practically given up hope when Rafael Joglar called out, "Craig, here's your *Uromacer*!" Sure enough, it was the Hispaniolan Shortnosed Vine Snake (*U. catesbyi*). It was fairly high up in a small tree, but after a bit of bank climbing, tree bending, and pole prodding, we had a *Uromacer* in hand. It is perhaps a bit ironic that this widespread Hispaniolan snake would be our prize, as the other two species of *Uromacer* on the island feed exclusively on lizards, whereas half of the diet of *U. catesbyi* is composed of … FROGS!

Acknowledgements

I thank Kevin Johnson, Richard Gibson, and Ron Gagliardo of the AmphibianArk for extending an invitation to me to attend the workshop. Funding to attend the workshop was provided by the Milwaukee County Zoological Gardens. I am indebted to the staff of ZooDom for their assistance with our "fieldtrips" and to Rafael Joglar for spotting the *Uromacer*. However, I am most deeply indebted to Blair Hedges, who was greatly missed at the workshop, but whose absence provided me with a seat in the bus to the Reserva Científica de Ébano Verde … and, of course, the rifle-toting guard at ZooDom.

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INTRODUCED SPECIES

First Record of the Lesser Antillean Frog (*Eleutherodactylus johnstonei*) in Puerto Rico

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Frogs of the genus *Eleutherodactylus* (family Eleutherodactylidae) are small to medium-sized anurans that constitute one of the main components of the West Indian herpetofauna. Particularly species-rich in the Greater Antilles, the taxon has speciated there to occupy ecological niches that include leaf litter, underground burrows, caverns, streams, bromeliads and mosses, tree holes, and crevices, all the way from dry lowlands to montane rainforests.

Eleutherodactylus johnstonei is a medium-sized member of the genus (maximum SVL 35 mm) that originated in the Lesser Antilles. This species has spread to many areas where it is not native (see Powell et al. 2011), most likely by hitchhiking — in the form of both adults and eggs — in agricultural produce.

After an afternoon of heavy rain, at 2013 h on 14 May 2011 on the grounds of the Gran Melia Hotel (Río Grande, Puerto Rico), I heard a single male *Eleutherodactylus johnstonei* calling. It was perched about 75 cm above the ground on the upper-side of a leaf of an exotic garden bush (species undetermined) planted outside a window of bungalow #20, about 220 m from the resort's main building. The location (18°25'13.61"N, 65°47'31.39"W) is at sea level and approximately 60 m from the beach. The identity of the frog was confirmed from photographs (MPM Herp P755) by S. Blair Hedges.

This male *Eleutherodactylus johnstonei* represents the first confirmed record of the species on Puerto Rico.

This is the first time *Eleutherodactylus johnstonei* has been reported from Puerto Rico (Powell et al. 2011). Other amphibians present on the grounds of the hotel were (in order of abundance): *Eleutherodactylus antillensis*, *E. coqui*, *Osteopilus septentrionalis* (exotic), *Rhinella marina* (exotic), and *E. cochranae*. With this record, the number of introduced amphibian species in Puerto Rico is seven. Within the West Indies this is the highest number of introduced amphibian species per island — despite the fact that Puerto Rico is the smallest of the Greater Antilles.

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CONSERVATION RESEARCH REPORTS

Museum Specimens Reveal the Coincidence of Neotropical Amphibian Declines and the Emergence of the Chytrid Fungus

Amphibians highlight the global biodiversity crisis because ~40% of all amphibian species are currently in decline. Species have disappeared even in protected habitats (e.g., the enigmatic extinction of the Golden Toad, *Incilius* [formerly *Bufo*] *periglenes*, from Costa Rica). The emergence of a fungal pathogen, *Batrachochytrium dendrobatidis* (Bd), has been implicated in a number of declines that have occurred in the last decade, but few studies have been able to test retroactively whether Bd emergence was linked to earlier declines and extinctions. **Cheng et al.** (2011. *Proceedings of the National Academy of Sciences of the United States of America* 108:9502–9507) described a noninvasive polymerase chain reaction (PCR) sampling technique that detects Bd in formalin-preserved museum specimens. The authors detected Bd by PCR in 83–90% (n = 38) of samples that were identified as positive by histology. They examined specimens collected before, during, and after major amphibian decline events at established study sites in southern Mexico, Guatemala, and Costa Rica. A pattern of Bd emergence coincident with decline at these localities was revealed — the absence of Bd over multiple years at all localities followed by the concurrent emergence of Bd in various species at each locality during a period of population decline. The geographical and chronological emergence of Bd at these localities also indicated a southbound spread from southern Mexico in the early 1970s to western Guatemala in the 1980s/1990s and to Monteverde, Costa Rica by 1987. The authors found evidence of a historical "Bd epidemic wave" that began in Mexico and subsequently spread to Central America and described a technique that can be used to screen museum specimens from other amphibian decline sites around the world.

CHARLES H. SMITH

Many amphibians have disappeared in recent years, even from apparently ideal habitat in protected areas. The enigmatic extinction of the Golden Toad (*Incilius periglenes*) in Costa Rica is a prime example. A fungal pathogen (*Batrachochytrium dendrobatidis*) has been implicated in many recent population declines, but whether the chytrid fungus was linked to earlier declines and extinctions has been unknown.

Demise of a Swedish Population of Adders

Madsen and Ujvari (2011. *Herpetological Conservation and Biology* 6:72–74) cited their previously published reports in 1999 and 2004 on how the introduction of 20 males into a severely inbred and isolated population of Adders (*Vipera berus*) halted its decline toward extinction. The introduction significantly enhanced the population's genetic variability, which resulted in a dramatic increase in offspring viability and a rapid increase in numbers. Unfortunately, a new and unprecedented development is threatening the population's survival. In 2004, permission was granted by the Swedish Nature Conservation Agency of the County Administrative Board to build a house and an adjacent 1-m tall brick wall across the habitat occupied by the Adders. The construction of the house and brick wall in 2006 prevented the majority of the snakes from undertaking their annual migration within the study area, resulting in the extirpation of > 75% of the snakes. This reduction seriously impedes the survival of this unique population.

THOMAS MADSEN

These male Adders (*Vipera berus*) are engaged in combat, presumably for reproductive rights. The red marks visible on one male allow for individual recognition. This photograph was taken before the recent population collapse.

Life History and Seasonal Variations in Chytridiomycosis in Crawfish Frogs

To fully comprehend chytridiomycosis, the amphibian disease caused by the chytrid fungus *Batrachochytrium dendrobatidis* (Bd), scientists must understand how Bd affects amphibians throughout their remarkable range of life histories. Crawfish Frogs (*Lithobates areolatus*) are a typical North American pond-breeding species that forms explosive spring-breeding aggregations in seasonal and semipermanent wetlands. However, unlike most species, when not breeding, Crawfish Frogs usually live singly — in nearly total isolation from conspecifics — and obligately in burrows dug by crayfish.

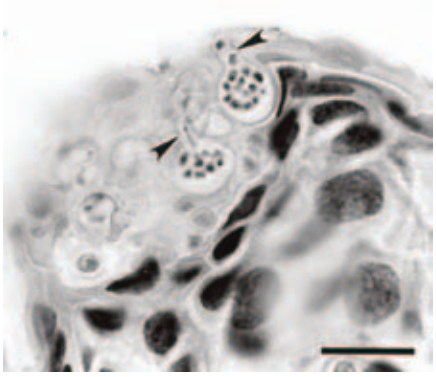
SUZANNE L. COLLINS, CNAH

Crawfish Frogs (*Lithobates areolatus*) are most vulnerable to the chytrid fungus when in crayfish burrows that penetrate the water table or when they breed in seasonal or semipermanent ponds.

Crayfish burrows penetrate the water table, and therefore offer Crawfish Frogs a second, permanent aquatic habitat when not breeding. Over the course of two years, **Kinney et al.** (2011. *PLoS ONE* 6(3):1–10) sampled for the presence of Bd in adult Crawfish Frogs. Sampling was conducted seasonally, as animals moved from post-winter emergence through breeding migrations, then back into upland burrow habitats. During the study, 53% of Crawfish Frog breeding adults tested positive for Bd in at least one sample; 27% entered breeding wetlands Bd positive; 46% exited wetlands Bd positive. Five emigrating Crawfish Frogs (12%) developed chytridiomycosis and died. In contrast, all 25 adult frogs sampled while occupying upland crayfish burrows during the summer tested Bd negative. One percent of postmetamorphic juveniles sampled were Bd positive. Zoospore equivalents/swab ranged from 0.8 to 24,436; five of eight frogs with zoospore equivalents near or >10,000 are known to have died. In summary, Bd infection rates in Crawfish Frog populations ratchet up from near zero during the summer to over 25% following overwintering; rates then nearly double again during and just after breeding — when mortality occurs — before the infection wanes during the summer. Bd-negative postmetamorphic juveniles may not be exposed again to this pathogen until they take up residence in crayfish burrows, or until their first breeding, some years later.

Strategies for Controlling Chytridiomycosis

Rescuing amphibian diversity is an achievable conservation challenge. Disease mitigation is one essential component of population management. **Woodhams et al.** (2011. *Frontiers in Zoology* 8(8):1–23) assessed existing disease mitigation strategies, some in early experimental stages, which focus on the globally emerging chytrid fungus *Batrachochytrium dendrobatidis* (Bd). The authors found that the effects of exposure to Bd occurred on a spectrum


MIDGLEY/DJ

Ventral hindlimb skin of a Harlequin Toad (*Atelopus varius*) from western Panama showing symptoms of chytridiomycosis. Two sporangia (spore-containing bodies of *Batrachochytrium* sp.) containing numerous zoospores are visible within cells of the stratum corneum. Each flask-shaped sporangium has a single characteristic discharge tube (arrow) at the skin surface. Exiting zoospores are visible in the discharge tubes of both sporangia. Hyperkeratosis is minimal in this acute infection. Tissues were fixed in neutral-buffered 10% formalin, embedded in paraffin, sectioned at 6 µm thick, and stained with hematoxylin and eosin. Bar = 35 µm.

from transient commensal to lethal pathogen. Management priorities are divided between halting pathogen spread and developing survival assurance colonies, and prophylactic or remedial disease treatment. Epidemiological models of chytridiomycosis suggest that mitigation strategies can control disease without eliminating the pathogen. Ecological ethics guide wildlife disease research, but several ethical questions remain for managing disease in the field.

Because sustainable conservation of amphibians in nature is dependent on long-term population persistence and co-evolution with potentially lethal pathogens, the authors suggested that disease mitigation not focus exclusively on the elimination or containment of the pathogen, or on the captive breeding of amphibian hosts. Rather, successful disease mitigation must be context-specific with epidemiologically informed strategies to manage already infected populations by decreasing pathogenicity and host susceptibility. They proposed population-level treatments based on three steps: (1) Identify mechanisms of disease suppression; (2) establish parameters for epizootiological models of disease and population dynamics that can be tested under semi-natural conditions; and (3) begin a process of adaptive management in field trials with natural populations.

Can Invasive Burmese Pythons Inhabit the Southeastern United States?

Understanding potential for range expansion is critical when evaluating the risk posed by invasive species. Burmese Pythons (*Python bivittatus*) are established in southern Florida and pose a significant threat to native ecosystems. Recent studies indicate that climate suitable for the species exists throughout much of the southern United States. **Dorcas et al.** (2011. *Biological Invasions* 13:793–802) examined survivorship, thermal biology, and behavior of Burmese Pythons from southern Florida in a semi-natural enclosure in South Carolina, where winters are appreciably cooler than in Florida, but within the predicted region of suitable climate. All pythons acclimated to the enclosure, but most died after failing to seek appropriate refugia during sub-freezing weather. The remaining snakes used refugia but died during an unusually cold period in January 2010. Although all snakes died during the study, most survived extended periods at temperatures below those typical of southern Florida, and none exhibited obvious signs of disease. This study represents a first step in evaluating the results of climate matching models and addresses factors that might affect range expansion in this invasive species.

Cold-induced Mortality of Invasive Burmese Pythons in Southern Florida

A recent record cold spell in southern Florida (2–11 January 2010) provided an opportunity to evaluate responses of an established population of Burmese Pythons (*Python bivittatus*) to a prolonged period of unusually cold weather. **Mazzotti et al.** (2011. *Biological Invasions* 13:143–151) observed behavior, characterized thermal biology, determined fate of radio-telemetered (n = 10) and non-telemetered (n = 104) Burmese Pythons, and analyzed habitat and environmental conditions experienced by pythons during and after a historic cold spell. Telemetered pythons had been implanted with radio-transmitters and temperature-recording data loggers prior to the cold snap. Only one of 10 telemetered pythons survived the cold snap, whereas 59 of 99 (60%) non-telemetered pythons for which data were available survived. Body temperatures of eight dead telemetered pythons fluctuated regularly prior to 9 January 2010, then declined substantially during the cold period (9–11 January) and exhibited no further evidence of active thermoregulation, indicating they were likely dead. Unusually cold temperatures in January 2010 were clearly associated with mortality of Burmese Pythons in the Everglades. Some radiotelemetered pythons appeared to exhibit maladaptive behavior during the cold spell, including attempts to bask instead of retreating to sheltered refugia.


LORI OBERHOFER

Invasive Burmese Pythons (*Python bivittatus*) are wreaking ecological havoc in southern Florida. Although in this instance, the snake is prey of an American Alligator (*Alligator mississippiensis*), pythons are efficient predators that are likely to imperil native species that include alligators.

Vulnerability of a Peripherally Isolated Population of Wood Turtle in Iowa

The North American Wood Turtle (*Glyptemys insculpta*) is a semi-aquatic species that is considered rare, threatened, or endangered over much of its range. **Spradling et al.** (2010. *Conservation Genetics* 11:1667–1677) monitored a particularly vulnerable peripherally isolated population in Iowa over a seven-year period. The authors compared population census size, estimated from mark-recapture data, age structure determined from morphology, and genetic variation using microsatellites of this peripheral isolate with data from a population nearer the core of the species range in West Virginia. They also compared gene flow between the Iowa population and a nearby population in Minnesota. Genetic data indicated that the Iowa population is isolated, unique, and diverse. Although the Iowa population has lower allelic richness, lower heterozygosity, and smaller genetic effective population size than does the West Virginia population, the difference is not dramatic despite its lower population size, position at the periphery of the species range, and biogeographic history. The Iowa population is not inbred, and the genetic signature is not indicative of a recent population bottleneck. However, interpretations of recent population dynamics based on genetic data may be unduly encouraging in long-lived species such as *G. insculpta*. Field data suggested a nearly complete lack of recruitment in Iowa. A number of environmental and anthropogenic factors, including recent increases in summer flooding during egg incubation, might have a more negative impact on the Iowa population than on the West Virginia population.


SUZANNE L. COLLINS, CNAH

An isolated population of Wood Turtles (*Glyptemys insculpta*) in Iowa is not inbred and no evidence points to a genetic bottleneck. However, recruitment to the population is near zero, which suggests that a number of environmental and anthropogenic factors might have a particularly negative impact on this population.

NATURAL HISTORY RESEARCH REPORTS

A Unique Insular Crevice- and Litter-dwelling Assemblage of Reptiles

The slopes above Chatham Bay on Union Island, St. Vincent and the Grenadines, support one of the last mature secondary forests in the Grenadines. The characteristics of the forest allow it to support a unique herpetofauna that includes four small crevice- and litter-dwelling reptilian species (*Gonatodes daudini, Bachia heteropa, Sphaerodactylus kirbyi,* and *Typhlops tasymicris*). **Bentz et al.** (2011. *Herpetological Conservation and Biology* 6:40–50) examined population sizes and densities, activity periods, microhabitat use, thermal biology, and water loss rates of these four presumably syntopic species to better understand these poorly known species and the unique ecological system of the forest floor on which they depend (see also Quinn et al. 2010. *Reptiles & Amphibians* 17:222–233). Their findings show that *G. daudini, S. kirbyi,* and *B. heteropa* are present in the ~37-ha area of forest above Chatham Bay at a ratio of approximately 2:1:12, respectively, and tentatively estimated total population sizes are about 6,600 *G. daudini*, 3,200 *S. kirbyi*, and 39,000 *B. heteropa*. Each of the four species was found to exploit separate microhabitats based on specific needs for cover, moisture, and thermal environments. The conditions necessary for these species to thrive apparently are available only in relatively mature forest situated to receive and hold moisture. This unique assemblage and the forest that supports it are under severe and imminent threat from exotic mammals and development, and the preservation of the area above Chatham Bay should be a high conservation priority for regional governmental agencies and non-governmental organizations.

MEL J. RIVERA RODRÍGUEZ

The Grenadine Sphaero (*Sphaerodactylus kirbyi*) was not known from Union Island until encountered by Joe Burgess in 2010. It is one of four species of small reptiles found together only on the forested slopes above Chatham Bay on Union Island.

MICHAEL KERN

A population of endangered San Francisco Garter Snakes (*Thamnophis sirtalis tetrataenia*) in a coastal prairie in San Mateo County appears to be stable or even increasing — at least in the short term. However, long-term studies of the status of San Francisco Garter Snakes at other sites are required to estimate population trends for this threatened snake.

San Francisco Gartersnake Demography

The San Francisco Garter Snake (*Thamnophis sirtalis tetrataenia*) has been federally listed as endangered since 1967, but little demographic information exists for this species. **Halstead et al.** (2011. *Journal of Fish and Wildlife Management* 2:41–48) examined the demography of a San Francisco Garter Snake population on approximately 213 ha of California coastal prairie in San Mateo County, California, from 2007 to 2010. The best-supported mark-recapture model indicated annual variation in daily capture probabilities and annual survival rates. Abundance increased throughout the study period, with a mean total population from 2008 to 2010 of 443 (95% CI = 313–646) individuals. Annual survival was slightly greater than that of most other garter snakes, with an annual probability of survival of 0.78 (0.55–0.95) in 2008–2009 and 0.75 (0.49–0.93) in 2009–2010. Mean annual per capita recruitment rates were 0.73 (0.02–2.50) in 2008–2009 and 0.47 (0.02–1.42) in 2009–2010. From 2008 to 2010, the probability of an increase in abundance at this site was 0.873, with an estimated increase of 115 (282–326) individuals. The estimated population growth rate in 2008–2009 was 1.52 (0.73–3.29) and in 2009–2010 was 1.21 (0.70–2.17). Although this population is probably stable or increasing in the short term, long-term studies of the status of the San Francisco Garter Snake at other sites are required to estimate population trends and to elucidate mechanisms that promote the recovery of this charismatic member of our native herpetofauna.

NEWSBRIEFS

Blue Iguana Rebounds from Near-extinction

One Caribbean species, the Blue Iguana of Grand Cayman Island, found nowhere else in the world, is looking like that rarest of things, a threatened species roaring back from the brink. Once down to perhaps fewer than a dozen animals, the long-tailed lizards, some growing to five feet and weighing 30 pounds, now number about 500, suggests a tally from a weeklong health screening that ended July 3.

"They are striking animals, turquoise blue with red eyes; they have an almost noble way they hold themselves," says conservation biologist Fred Burton, head of the Blue Iguana Recovery Program, "but they were almost a forgotten animal." Biologists knew about the animal, with an Oxford University expedition first describing them scientifically in 1938. But they had disappeared from the island as farmers planted more land and roads stretched across the island as well. Farmers' dogs killed the lizards and cars ran them over as they basked on the asphalt. "Cats, feral cats, were really the problem, we have them everywhere and these are very hungry animals," Burton says. The cats ate young iguanas in droves.

Biologists didn't know how bad things had gotten for the Blue Iguana until 2002, when Burton implored his colleagues, meeting that year on the island for discussions of iguana conservation across the Caribbean, to stay and craft a conservation plan for Grand Cayman's own


JOHN BINNS

The Blue Iguana (*Cyclura lewisi*) of Grand Cayman Island is looking like that rarest of things, a threatened species roaring back from the brink of extinction.

native lizard. To do that, they needed to survey the population. That's when they realized they had a big problem. "We just weren't seeing any. And the ones we were seeing were far apart from each other, which isn't what you want for mating," Burton says.

"There was a sort of 'oh no' moment," says Paul Calle, zoological health director for the Bronx Zoo-based Wildlife Conservation Society's Global Health Program. "They quickly realized they had to do something." That something was captive breeding, Burton says, done with a purpose. "We didn't know how they lived or what they ate." So, his team started rearing its own iguanas, keeping them to various ages, letting them go and tracking their behavior. "We learned a lot. We had been feeding them rabbit food basically, all wrong, and keeping them in pens that were too small," he says.

Blue Iguanas eat all sorts of vegetation, but they really like fruit, it turns out, which was part of their downfall. They had congregated within fruit orchards, which the dry scrubland they called their home was becoming on the island. There they met farmers' dogs and cats.

Along with learning how to rear Blue Iguanas, the team learned when to release them, at two years of age, big enough to fend off the feral cats. And they found a place to put them, in two reserves without roads or farms but with the dry scrub favored by the lizards. "They lay a lot of eggs, which is another thing in their favor," Burton says. "Many of the ones we released are now reaching breeding age, so their numbers should really grow."

At the health screening, which checked out captive-grown lizards prior to their release, "I saw more Blue Iguanas in one day than the entire species possessed less than a decade ago," Calle says. "It is a remarkable turnaround."

Burton concedes that the lizards benefited from circumstances that other endangered species lack. Their hard-wired habits allowed an easy transition from captivity into the wild, for example, while large egg clutches let the conservation team raise many iguanas. And this year the conservation trust secured a second Blue Iguana redoubt, the Colliers Wilderness Reserve, for their preservation.

Within two years, the project estimates the iguana's numbers will top 1,000, the target set for their recovery almost a decade ago. The challenge will then be not letting the problems that clipped their numbers before once again take their toll, Calle says. Instead of breeding captive lizards, recovery efforts will have to turn to keeping the reserves open to tourists, but not feral cats.

On the plus side, everyone on Grand Cayman, which is just south of Cuba, knows about Blue Iguanas now, which should make such efforts easier, Burton says. "They are quite the mascot of the island. We have stores named after them and cruise ships stop to see them. I think everyone here is quite proud of them."

Dan Vergano
USA Today

Rediscoveries of "Lost Frogs" a Boon for Biodiversity

Eli Greenbaum, a faculty member from The University of Texas at El Paso rediscovered four species of frogs during a recent African expedition. These discoveries bode well for the planet's endangered biodiversity. Dr. Greenbaum made the discoveries with African collaborators during his fifth venture to the Democratic Republic of Congo earlier this year.

The expedition, which was funded by the university, followed on the heels of an effort by the Washington, DC-based organization Conservation International to send 126 researchers into 21 countries to find over 100 amphibians that have not been seen for decades. Only fifteen "lost" species were rediscovered in that worldwide effort last year, causing alarm among scientists.

The discoveries by Greenbaum's team have highlighted the need for conservation efforts in the remote mountains of eastern Congo. He also rediscovered a fifth species, an African Puddle Frog (*Phrynobatrachus asper*, described in 1951) during a 2009 trip to the Congo sponsored by the National Geographic Society. The legs of these frogs have so much meat on them that this species was rediscovered in 2009 when villagers on the Itombwe Plateau offered to sell their frog dinner to the scientists! These people led the research team to the frog's natural habitat in streams that run through pristine highland forest.

The five rediscovered species were described without photographs between 1950 and 1952, and hadn't been seen since. They include the species illustrated here and on the inside front cover plus the thumbnail-sized *Arthroleptis pyrrhoscelis*, endemic to grasslands of the Itombwe Plateau at an elevation of ~2,000 m. Frogs in this genus have direct development, where the eggs hatch into tiny froglets, bypassing the more typical aquatic tadpole stage. In addition, *Hyperolius chrysogaster* was last seen in 1954. This frog has been found only in pristine montane forests near Kahuzi-Biega and Virunga National Parks. Forests across eastern Congo are being destroyed rapidly for agricultural use, hastening the extinction of many species from frogs to gorillas.

Recent assessments concluded that a third of the world's amphibian species have become extinct or are seriously threatened with extinction, so Greenbaum's efforts offer a glimmer of hope. "This is important for the sake of conservation on a global scale," he said. "Amphibians are like the canaries in the coal mine. If they go, we're next and they're not doing too good."

The Center for North American Herpetology
24 May 2011
(adapted from a CNAH announcement and Dr. Greenbaum's website, http://eligreenbaum.iss.utep.edu/lost_amphibians.htm)


ELI GREENBAUM

Hyperolius leucotaenius, described in 1950: This treefrog was rediscovered on the banks of the Elila River in the upper elevations of the Itombwe Plateau. The skin on the dorsum of this female is so transparent that you can see her eggs.

Editors' Remarks

MIKLOS SCHIBERNA

Frilled Lizard (*Chlamydosaurus kingii*)

The International Reptile Conservation Foundation and *Reptiles & Amphibians* are delighted to make an appearance at the Australian Herpetological Symposium 2011, themed "Rare and Endangered." We welcome symposium participants to join us in our mission to conserve reptiles and amphibians and the natural habitats and ecosystems that support them. The editors of *R&A* would like to encourage new IRCF members to submit articles about the herpetofauna of your homeland. To us, the reptiles and amphibians of Australia are quite exotic and of great interest. Just as we enjoy sharing our experiences in the Americas, we would like to see more from you about your own special creatures.

The Editors of *R&A*

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IRCF, REPTILES & AMPHIBIANS, CONSERVATION AND NATURAL HISTORY, the Journal of The International Reptile Conservation Foundation, is distributed quarterly.

Annual Rates:

Individual U.S. Membership	$25.00
Individual Membership, Digital (Adobe PDF)*	$25.00
Institutional U.S. Subscription	$30.00
International Membership (including Canada)	$55.00
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 IRCF, Reptiles & Amphibians, Conservation and Natural History (ISSN 1098-6324) is published quarterly by the International Reptile Conservation Foundation, a nonprofit, tax-exempt organization, PO Box 90270, Tucson, AZ 85752. Periodical postage paid at Tucson, AZ.

COMMENTARY

A Professional Journal for All Herpetologists[1]

Wolfgang Böhme

Bonn, Germany

When people focus their attention on amphibians and reptiles — by inclination instead of commercial motives, of course! — this interest essentially plays itself out on three main levels: The vast majority of these individuals are simply fascinated and inspired by the variety of shapes, the bizarre appearance, and the aesthetic beauty of many amphibians and reptiles. People at this level often have the desire to care for these animals in a terrarium in their own homes in order to learn more about them and how they live. Ultimately, they want to communicate their experiences and also learn from the knowledge of others.

A second, smaller group of people with longer-term and greater experience desires contact not only with like-minded individuals, but also with professional scientists. These individuals would like to share their experiences with the scientific community and allow their previously unknown observations on the biology and behavior of amphibians and reptiles to contribute to the growth of knowledge.

Finally, a relatively small number of professional herpetologists endeavor to solve the many outstanding questions regarding the systematics, distribution, ecology, behavior, and biology of amphibians and reptiles using a variety of academic research methods.

As most professional herpetologists are motivated by their own interests in amphibians and reptiles in the same way as the two aforementioned groups, they certainly will benefit from maintaining close contact with those groups and to support their efforts. The best means to accomplish all of these endeavors is through an up-to-date, regularly published journal. Therefore, the provision of publications that serve the needs of all three groups is of the utmost importance.

So far, only the second group — the dedicated hobbyist/would-be scientists — has ready access to a suitable herpetologically oriented publication. On the purely scientific level, however, a professional herpetological journal of sufficient caliber and yet capable of facilitating communication between all three groups is lacking. The situation for the largest group, the hobbyists interested in amphibians and reptiles, is quite similar. Although some magazines publish interesting and popular reports applicable to our area of interest, amphibians and reptiles often play a minor role in publications largely dominated by fish.

I therefore enthusiastically welcome the efforts of the editors of *Herpetofauna* to create a journal dedicated exclusively to amphibians and reptiles that will contain articles that provide hobbyists the necessary, extended opportunity not only to learn, but also to share information with others. In my endeavor to promote an interest in and knowledge of amphibians and reptiles at all levels, I wish this journal a good start and pledge it my full support.

[1] Adapted from the *Geleitwort* (= Foreword) in the first issue of *Herpetofauna*, published in Ludwigburg-Oßweil, Germany in June 1979. Translated by AJ Gutman.

"Us" versus "Us & Them" *Reptiles & Amphibians* and the Need for Common Ground

Wolfgang Böhme's comments of more than three decades ago still ring true in America today. Although the European (and especially German) herpetological community has long been characterized by fruitful communication and collaboration between professionals and amateurs, this has not been the American experience. Now, as for most of the last 50 or more years, communication between the three groups of herpetologists described by Böhme has been limited at best. Even the serious amateurs interested in both consuming and contributing to the literature are largely alienated by the ever more technical nature of the professional journals in the field. Likewise, hobbyist magazines focused chiefly on husbandry are of little interest to professionals and are often unsatisfying to more serious and sophisticated amateurs as well. Natural history (in the broad sense), however, provides a common ground for all herpetologists, capturing many of the elements that drew most of us to reptiles and amphibians in the first place — their diversity, their lifestyles, and their aesthetics. Natural history is "good" science that is also accessible science. A well-written natural history article can be as interesting, useful, and understandable to a beginning hobbyist as to a seasoned academic. *Reptiles & Amphibians*, with its focus on natural history and conservation (another topic of critical concern to all herpetologists), is one of the few publications that can provide the link between the various segments of the herpetological community through its compelling all-color articles on broad-ranging topics. With continued support, both in the form of subscriptions and especially article submissions, by herpetologists of all stripes, *R&A* can foster communication between all herpetologists and help to break down the historical divide between amateurs and professionals.

Aaron M. Bauer
Department of Biology, Villanova University

THOMAS WIEWANDT

Slow-moving giant twig anoles, such as this Cuban False Chameleon (*Anolis chamaeleonides*), are found only in Cuba. These odd lizards were until recently placed in the genus *Chamaeleolis*. This is one of over 100 species of reptiles endemic to Cuba. See the travelogue on p. 168.