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Grand Cayman Blue Iguana, *Cyclura lewisi*, Grand Cayman, Cayman Islands (see story p. 148). Photograph by Fred Burton.



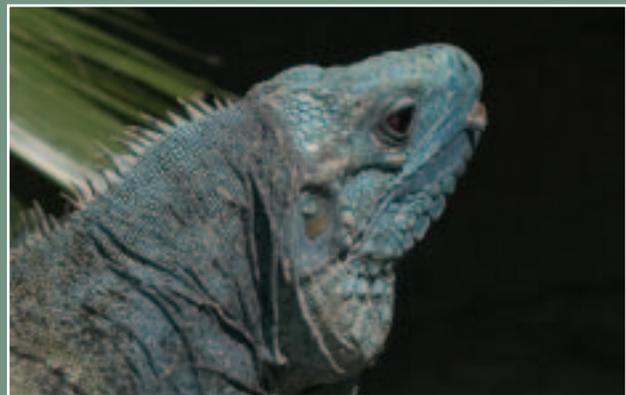
Adult female Lesser Antillean Iguana (*Iguana delicatissima*): females retain the green color longer than males; however, eight months after this photo was taken, green was restricted to the lower flanks. See article on p. 138. *Photograph by Robert Powell.*



Color and pattern change with age in Grand Cayman Blue Iguanas (*Cyclura lewisi*), but are the most reliable means of diagnosing the species. See article on p. 148. *Photograph by John Binns.*



Green Iguana populations continue to grow in the disturbed habitats of southern Florida. See article on p. 154. *Photograph by John Binns.*



Staff at the Gladys Porter Zoo in Brownsville, Texas, say a fond farewell to Godzilla, who died recently at an estimated age of 69. See story on p. 168. *Photograph by John Binns.*



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Sister Isles Rock Iguana (*Cyclura nubila caymanensis*), Little Water, Cayman Islands. *Photograph by John Binns.*



Although some females were quite large, they usually retained some green color along their lower sides. *Photograph by Robert Powell.*



Adult female in a private garden on the lower leeward slope of The Quill. Iguanas were abundant in this area, with each lushly planted plot supporting at least 1–3 individuals. Animals were not bothered by the sharp-edged leaves of the “Razor Plant.” *Photograph by Robert Powell.*



Sint Eustatius

Sint Eustatius, showing localities mentioned in the text. *Illustration by John Binns (modified from an original by John S. Parmerlee, Jr.).*

Revisiting St. Eustatius: Estimating the Population Size of Lesser Antillean Iguanas, *Iguana delicatissima*

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The Lesser Antillean Iguana, *Iguana delicatissima*, is in trouble. The species is listed in CITES Appendix I and as “vul-



Iguanas basking or resting in trees blended in well and were often difficult to see. Although large adults are relatively immune from predation, juveniles may be taken by large snakes (*Alsophis rufiventris*) or birds-of-prey, such as Red-tailed Hawks (*Buteo jamaicensis*) or American Kestrels (*Falco sparverius*). Photograph by John S. Parmelee, Jr.

nerable” in the most current IUCN Redlist. As for all island species, especially those on small islands, populations are at constant risk of extirpation. Islands of the Lesser Antilles, although they can provide suitable habitat, are less than ideal for a large animal on the brink of extinction. Most islands are small, which inevitably leads to small population sizes and an increased risk of extirpation due to natural or human-mediated, stochastic or non-random events. Human population growth with accompanying habitat destruction and alteration, introduction of alien predators and competitors, and ongoing hunting pressure all contribute to the iguana’s plight.

The species’ original range, from Martinique in the south to Anguilla in the north, is shrinking. Populations have been extirpated on Barbuda, Saint Kitts, Nevis, Antigua, Les Îles des Saintes, Marie Galante, and St.-Martin/St. Maarten. Michel Breuil recently listed the populations on Dominica, Îles de la Petite Terre, and La Désirade as vulnerable; those on Basse-Terre, Îlet Chancel (Martinique), and St.-Barthélemy as endangered; and those on Antigua, Anguilla, Barbuda, Île Fourchue and satel-



View of Statia from Boven Hill: the rugged Northern Hills are in the foreground, a portion of the Cultuurvlakte, the central plain, is visible, and The Quill is in the background. Photograph by Sean P. Fogarty.



An adult male in the Northern Hills, where iguanas were locally abundant, especially along forested ridges and in densely vegetated guts in this relatively xeric area. *Photograph by Sean P. Fogarty.*



An adult female regularly spent the night in this Tamarind Tree. Here she awaits the early morning sun. Tamarind leaves were commonly eaten. *Photograph by Robert Powell.*

lites (St.-Barthélemy), Grande-Terre, Martinique, St.-Martin, and St. Eustatius as critically endangered — and those on Antigua, Barbuda, and St.-Martin/St. Maarten have already disappeared.

Sint Eustatius, commonly known as Statia, is the northernmost island on the St. Christopher (St. Kitts) Bank, which also includes St. Kitts and Nevis. Within its 19.9 km² live 2900 people and about 8000 goats. The most noticeable feature of the Statian landscape is The Quill, a 600-m tall dormant volcano in the southeastern corner of the egg-shaped island. The Northern Hills lie in the smaller end of the “egg” at the northwestern corner of the island. Although not especially tall, with Boven Hill rising the highest at 289 m, these hills are characterized by steep slopes and deep guts (gullies). Between The Quill and the Northern Hills lies the Cultuurvlakte, the island’s central plain. Vegetation on the island ranges from extremely dry scrub and woodland in the northern hills to lush evergreen seasonal forest inside the crater of The Quill.

In 2000, Steven Reichling published a report stating that fewer than 300 iguanas remained on Statia when he visited in November 1999. This followed a 1992 population estimate by Mark Day and Brian Leysner stating that approximately 300 animals were on the island. We have no further information regarding the methods used in the latter study. However, the apparent population decline is similar to what has been seen on islands elsewhere in the Lesser Antilles, where once abundant iguanas have suffered from habitat encroachment, overhunting, competition for food with feral livestock (goats, cattle, and burros), and predation by mongooses, rats, dogs, and cats. In addition, on at least some islands, introduced Green Iguanas (*Iguana iguana*) compete for habitat and food and, in some instances, have hybridized with native *I. delicatissima*.

The 2004 Survey

In June 2004, we attempted to update the current status of the species on Statia. While a density estimate was not the main objective of our trip, it developed naturally from the behavioral work in which we were already engaged. That research required searching for both wild and human-habituated iguanas over much of the island. Most of our work focused on three areas, Gilboa Hill, the estates on the northwestern slope of The Quill, and the cliffs above Smoke Alley Beach. In each of these areas, we saw and recorded most of the iguanas present. We also saw animals on Boven Hill and on the western slope of The Quill.

Overall, we saw 33–37 different individuals on the island, with about 22 of these in habitats not frequented by humans. We spent 28–30 hours searching in the Northern Hills and approximately 85 hours looking for snakes on The Quill. We also spent approximately four hours looking for animals in landscaped gardens around private residences (numbers of search hours are rough estimates, since most of our time was spent observing rather than searching for iguanas).

We estimated relative densities, as Reichling did, by calculating the hours searched per iguana seen. We also used the same seven habitat zones described in his paper: Quill crater, outer slopes of The Quill, foothill scrub around the base of The Quill, Island Estates development, Cultuurvlakte (central plain), foothills and guts bordering the Northern Hills, and the Northern Hills themselves (Boven, Gilboa, Little Mountain,

Signal). The only time spent in the foothill scrub at the base of The Quill and in the foothills and guts bordering the Northern Hills was in transit to other areas. We saw no iguanas in either area. Hours searched per iguana seen in other areas were: Northern Hills — 1.8 (0.7 on Gilboa and 3.3 on Boven; Reichling 2.75), Island Estates — 0.2 (Reichling 1.8), outer slopes of The Quill — 8.3 (this is relatively high, but observers in this area were not looking primarily for iguanas; Reichling found none), and Cultuurvlakte — 0.4 (all along the cliffs above Smoke Alley Beach; Reichling found none). Reichling found one iguana per 7.3 search hours in the northern foothills and guts, where we did not search. Note that all of our data are in hours searched per individual iguana seen, not per sighting, as multiple sightings of the same individual would have inflated our numbers (when in doubt regarding the identity of a given individual, i.e., whether previously seen or not, we erred on the side of caution). However, our Cultuurvlakte and Island Estates encounter rates are undoubtedly high, since we searched only in areas where we knew that iguanas occurred.

Our sighting rates were much higher than we had anticipated from the data that Reichling had presented. Therefore, we believed that an adjusted whole-island population estimate was justified. In order to do this, we used the same habitat zones as before. Our observations on Gilboa Hill were made in what we designated “optimal” and “good” habitats. Based on similarities in topography and vegetation, we identified “optimal” and “good” and “other” habitats in the entire Northern Hills, for which we calculated areas. We then extrapolated from our encounter rates on Gilboa Hill to the entire Northern Hills, resulting in a population estimate of 174–404 for that region of the island.

During our visits to the grounds of three private residences in the Island Estates area, we found three iguanas in each. By conservatively estimating that comparable numbers of individuals lived in at least one- to two-thirds of the 63 estates in the area, we estimated that approximately 63–126 animals occur in this area.

We had to employ different techniques to estimate the population sizes in other areas, such as the outer slopes of The Quill, the Smoke Alley cliffs, and sites at which locals indicated iguanas were present. We assumed that population densities were lower than in the Northern Hills because (1) Reichling saw no animals on The Quill, (2) our encounter rates were relatively low (predicated, at least in part, by the fact that most person-hours on The Quill were by observers looking for terrestrial snakes along well-established trails, rather than largely arboreal iguanas that may well have been more common in areas far from the trails), and (3) the degraded state of much of the understory vegetation, attributable largely to the ubiquitous feral goats. However, the area is extensive, includes considerable suitable habitat, and the fact that individuals using a very different search image found iguanas collectively suggest that a substantial population exists. Based largely on our encounter rates and the proportion of the total area of the slopes surveyed, we estimate that 30–60 iguanas occupy the slopes of The Quill.

The Smoke Alley cliffs, above which the King’s Well Hotel is located, are home to several individuals. At least five to seven animals live on that portion of the slope behind the hotel, in



This adult male was foraging for fallen fruit on the Smoke Alley cliffs. Unlike females, large males lose all traces of the green coloration typical of juveniles. *Photograph by John S. Parmerlee, Jr.*



Even before exposure to direct sunlight, thermal images revealed that iguanas were considerably warmer than their environment. *Photograph by John S. Parmerlee, Jr.*



Acclimated to humans, this female responded to the photographer's presence only after a very close approach. *Photograph by Robert Powell.*

what may be the highest density on the entire island. As many as 14 individuals were known to occur in that limited area until very recently (within the past two years) and evidence of reproduction exists in the form of juveniles observed at several locations as far along the cliffs as the office of the St. Eustatius National Parks Foundation (STENAPA) near the harbor. Based on actual observations and a crude assessment of habitat quality, a conservative estimate of population size in this area is 10–50 individuals.

Other areas in which locals indicated that iguanas were present and which had been cited in the literature as good iguana habitat include the English Quarter, the nearby foothill scrub habitat, and comparable habitat extending around The Quill to the north and east. Because we did not search there and the habitat is severely degraded, much of it overgrown with Mexican Creeper (*Antigonon* sp.), we were uncomfortable counting any iguanas in those areas, although isolated pockets of suitable habitat probably support a few individuals.

When we combined all of our population estimates from the areas listed, the worst- and best-case scenarios were 275 and 650, respectively. Very subjectively evaluating our assessments of the island's habitats and the current status of threats to the population, we believe that the most likely population size is about 425. Because we assumed that no iguanas occupied areas where we were unable to confirm any individuals (notably those portions of the Northern Hills we did not visit, the Quill crater, and the lower slopes of The Quill, which include the English Quarter), our numbers should be considered highly conservative.

That this estimate is nevertheless considerably higher than Reichling's estimate of fewer than 300 animals in 1999 is not surprising. We saw half again as many animals while expending less time and effort. Our estimate also exceeds Day and Leysner's 1992 estimate of 300 individuals. This is good news, but could it be an illusion?

Growing Population or Artifact?

The circumstantial evidence suggests that the apparent upturn in the iguana population is real. First, locals in the Island Estates area indicated to us that the number of sightings of iguanas crossing roads has been growing in recent years. These areas are relatively immune from iguana hunting, because much of the area consists of large, gated properties. Also, animals that live on the grounds of protected private residences are undoubtedly reproducing, resulting in the repopulating of the adjacent Quill slopes. Second, we found animals on the slopes of The Quill, where Reichling saw none in either 1992 or 1999. Third, while he was unable to find animals on the Smoke Alley cliffs in 1999, they are now relatively abundant. The King's Well Hotel, which had been holding and breeding animals at the time, released 14 animals sometime after Reichling's visit. These animals and their offspring seem to be thriving. Fourth, when two of us initially went scouting for iguanas in the Northern Hills, having never seen iguanas in a natural setting, we found three iguanas in the first four hours of searching! This was a far higher density than any of us had expected, especially for inexperienced spotters. Finally, two other

variables strongly suggest support for the higher numbers, the incidence of hurricanes and an apparent decline in hunting pressure.

Several long-time Statian residents independently commented that iguanas become very difficult to find for periods of up to several months after major hurricanes. They attributed this to disruptions of habitats and defoliation of most plants that would usually provide cover and food. The 1992 population estimate was probably not affected by hurricanes, as three years had passed since Hugo in 1989. However, hurricanes may have dramatically affected the 1999 estimate. When Reichling made his observations in November 1999, José, a category one hurricane, had passed within 15 nautical miles in October and Lenny, a category four, had passed within 29 nautical miles just days earlier. In addition, Georges, a category 3 hurricane, had passed within 14 nautical miles of Statia the year prior. The combined effects of these hurricanes on the iguana population is difficult to assess, but may well have been responsible for the decline in numbers between 1992 and 1999, and may account, at least in part, for the apparent increase in the numbers of iguanas during the hurricane-free years subsequent to Reichling's visit.

Iguanas have been a source of food to islanders since Amerindians first arrived on Statia. Even today, some men on the island, particularly non-resident workers from other Caribbean islands, apparently believe that eating iguana will enhance their

sexual energy. Also, Nicole Esteban, Director of STENAPA, still receives occasional reports of iguana barbecues. However, based on equally anecdotal evidence, the problem appears to be less pervasive than during the 1990s. At that time, long-term residents reported that they routinely saw kids carrying iguanas to town in an effort to acquire some spending money. Whether educational efforts (see below) are paying off, more Statians are beginning to understand the value of having iguanas on the island, or merely because the availability of goods is better now, the potential benefits of poaching iguanas seem to be diminishing.

Ongoing Conservation Concerns

The principal threat to Statia's iguanas remains habitat alteration and degradation. Although the human population is not growing rapidly, improvements in infrastructure and any new construction, especially if they impinge on either the Northern Hills or the slopes of The Quill, have the potential to reduce available habitat. Of greater concern is the ongoing degradation of natural vegetation attributable to the spread of invasive alien species, most notably the Mexican Creeper (*Antigonon* sp.), and to the largely unchecked impact of feral herbivores. Goats, burros, and even cattle are abundant, and range freely in even the most "natural" areas. Aggravating the problem is the fact that goats will eat the Creeper only in the absence of other forage (iguana are presumably just as discriminating). Ongoing efforts at the Botanical



Iguanas were locally abundant along the Smoke Alley cliffs, where at least some individuals were formerly held captive at the King's Well Hotel. *Photograph by Robert Powell.*



Shaded by The Quill and the cliffs, iguanas sleeping in trees often remained in place until the mid-morning sun provided ample heat. *Photograph by Robert Powell.*



Goats are abundant and ubiquitous in even the most remote locations, such as this hillside in the Northern Hills. They have dramatically degraded the natural vegetation and often compete directly with iguanas for food. *Photograph by Sean P. Fogarty.*

Garden, situated on the windward eastern slope of The Quill, dramatically illustrate the problem. Fences exclude goats but not the Creeper, and, as the latter grows over the fences, its dense growth provides access to the goats. Continually removing the invasives is labor-intensive and unproductive in the long term. Unless biological agents can be employed to reduce the incidence

of the Creeper and the goat population is either contained or dramatically reduced in size, iguanas will survive only in localized pockets extremely vulnerable to exploitation or stochastic events.

The Quill and the Northern Hills have been designated parts of Statia's national park system, and consequently are afforded some protection against development, if not against goats and invasive plants. Because the promotion of ecotourism to complement excellent offshore diving opportunities is the most likely means of enhancing the nation's economic growth, reasonable hope exists that current disputes over ownership of the Northern Hills and the problems created by too many goats will eventually be resolved in favor of nature — and therefore the iguanas, which themselves could serve as a tourist attraction. In the immediate future, we can only hope that the situation does not deteriorate so quickly that more enlightened policies can be instituted and effectively enforced in time.

Predation by both humans and animals also remains a concern. Although mongooses are not present on Statia, dogs and cats are abundant. Both have been shown to cause declines in iguana populations throughout the West Indies. Even if pets remain, efforts to control feral predators should be employed. Human predation appears to be declining, and ongoing educational efforts, largely by STENAPA, should have an increasingly greater impact, as today's students become involved in developing and implementing policies. Although iguana hunting is already illegal and fines have been legislated, enforcement is essentially nonexistent. Consequently, a complete cessation of hunt-



This iguana (indicated by the arrow) seems to be seeking protection from the sign that had just been posted on the lower slopes of the Smoke Alley cliffs. Fourteen of these signs were provided to the St. Eustatius National Parks Foundation by the IIS. *Photograph by Victoria H. Zero.*



Although primarily arboreal along the Smoke Alley cliffs, iguanas were not adverse to crossing open ground, even pausing to bask for short periods. *Photograph by Robert Powell.*



This bright green juvenile basking in a palm tree above the Smoke Alley cliffs is testament to successful recruitment. *Photograph by Robert Powell.*

ing activities will depend on widespread public support that should increase, as students, who now benefit from environmental programs in the schools, become actively engaged citizens. Problems with guest workers from other islands, many of whom see iguanas only as a resource to be exploited, will continue — but should be more readily addressed if locals cease hunting animals and begin to view them as an economic asset.

Acknowledgements

Nicole Esteban and the staff, interns, and volunteers at STENAPA were immensely helpful during our stay on Statia. Heather Heinz (North Carolina State University), Trevor Joyce (University of Alaska Southeast), Abigail Maley (Ohio Wesleyan University), Aaron Savit (St. John's College), and Robert Henderson (Milwaukee Public Museum) all contributed field observations. Fieldwork was funded by grant No. DBI-0242589 awarded by the National Science Foundation to Robert Powell.

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SPECIES PROFILE

Red-bellied Racer (*Alsophis rufiventris*)

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Among West Indian snakes, only the Dwarf Boas (*Tropidophis*) and the Blind Snakes (*Typhlops*) are represented by more species than the Racers (*Alsophis*). Racers are variable in color and pattern and members of the same species may look quite different on different islands. In the Lesser Antilles, home to five species of *Alsophis*, each is found on only one or a few islands. *Alsophis antillensis* is the most widely distributed, occurring on the Monserrat, Guadeloupe, and Dominica island banks. *Alsophis rijgersmaei* is found on the main islands of the Anguilla Bank, *A. rufiventris* on the Saba and St Christopher (St. Kitts) banks, *A. antiquae* on the Antigua Bank, and *A. sanctonum* on the Isles des Saintes Bank near Guadeloupe. The introduced Mongooses (*Herpestes javanicus*) poses a threat to most species of Racers on one or more islands, and several populations have been extirpated. The Red-bellied or Black Racer, *A. rufiventris*, for example, has been extirpated from Nevis and St. Kitts, and occurs today only on mongoose-free Saba and St. Eustatius (Statia).

On Saba and Statia, *Alsophis rufiventris* is widely distributed. It is a habitat generalist, found in disturbed and natural areas from near sea level to some of the highest elevations on these islands. It has been observed on the rim of The Quill at an elevation of 550 m on Statia, and within 30 m of the 864-m top of Mount Scenery on Saba. On St. Eustatius, this snake is most commonly encountered in shaded, rocky areas, which also harbor the densest populations of *Anolis schwartzi*, the predominant prey of *A. rufiventris* on Statia.

Like other members of the genus, *Alsophis rufiventris* is an actively foraging diurnal predator. Although primarily terrestrial, it sometimes ascends into shrubs and trees. Observations on Statia indicate that it spends roughly half of its time moving, with about half of that time spent searching for prey in leaf litter, under dead-fall, or in the abundant crevices of rock piles. Once a prey item has been seized, the snake may inject a weak venom to subdue its victim. *Alsophis rufiventris* is a non-aggressive species that rarely bites. Even if it does, it is generally considered to be harmless, as its venom infrequently elicits even mild reactions in humans. Like all other species of *Alsophis*, the Red-bellied Racer is oviparous, but little else is known about its reproduction.

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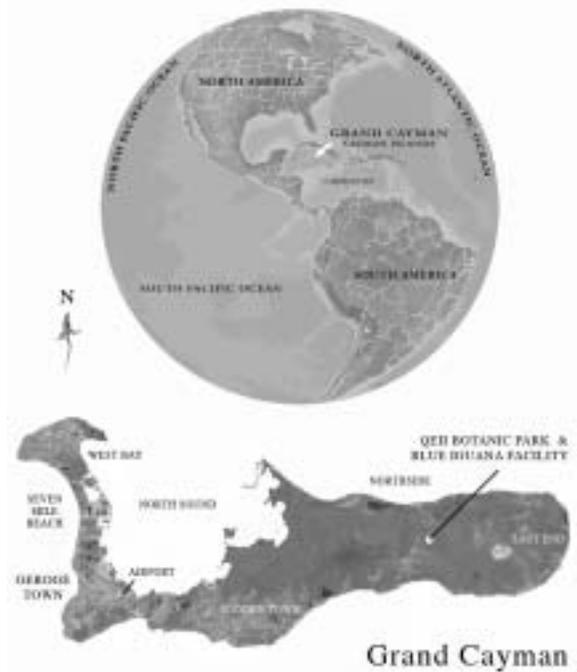
Adult *Alsophis rufiventris* from St. Eustatius (top) and from Saba. Photographs by John S. Parmelee, Jr.



Founder male Daniel, 13 years old at the time of this photograph, is breeding successfully in a large open-air pen at the Blue Iguana Recovery Program's captive breeding and head-starting facility on Grand Cayman. *Photograph by John Binns.*



Potential founder male, Hal, was until recently in illegal captivity and is now recovering from a decade of chronic malnutrition. He mated in 2003 and 2004, but so far remains infertile.



Location of Grand Cayman in the north-west Caribbean, the only island where *Cyclura lewisi* occurs. *Illustration by John Binns.*

Color and Pattern in Grand Cayman Blue Iguanas

Fred Burton

Blue Iguana Recovery Programme, Grand Cayman Island

Photographs by author, except where indicated.

In a recent paper in *The Caribbean Journal of Science*, I relied on several different lines of evidence to formally conclude that the Grand Cayman Blue Iguana is a full species, *Cyclura lewisi*. The old classification, in which the Blue Iguana was considered to be a subspecies of the Cuban Iguana (*C. nubila*), didn't make much sense after 2000, when Catherine Malone and her colleagues showed that Cuban Iguanas and the iguanas from Little Cayman and Cayman Brac are, if anything, more closely related to the Bahamian species (*C. cyclurina*) than they are to Blues.

Apart from DNA, the most diagnostic feature distinguishing the Blue Iguana is the color of adults. The remarkable bright

blue of adult *C. lewisi* was first described by Chapman Grant in 1940, but the color patterns of hatchlings and subadults have never been reported in detail.

When they first emerge from the nest, Blue Iguana hatchlings are intricately patterned, very much like hatchlings of *C. nubila* and *C. cyclurina*. The head and dewlap are pale bluish gray and unmarked, except in some individuals, which may show subtle dark marks just behind the eyes. The interparietal scale (the "pineal eye" in the middle of the back of the head) is particularly pale, and the nostrils are narrowly rimmed with black. The iris of the eye is golden and essentially fills the exposed area of the eye. The surrounding sclera is reddish but rarely seen at this age.

Starting at the neck and proceeding down the length of the body is a pattern of dark "chevrons" — looking down from above, they appear as a series of V's running diagonally back and down both sides of the body. From the side, they look like diagonal dark stripes on a paler background, running from the neck and back rearwards down the flanks to the belly. To some people, they look like pale stripes on a dark background — I guess it all depends on your point of view.

This pattern starts with an inconspicuous, very short, dark gray chevron starting near the front of the incipient nuchal (neck) crest. Viewed from above, this and a conspicuous second dark chevron are U-shaped, curving over the neck crest. The ends of the second chevron turn downward to stop above the front legs. The third and subsequent chevrons are V-shaped from above and somewhat wavy on the flanks, sometimes breaking up lower on the sides. Eight chevrons usually are present between the beginning of the nuchal crest and the pelvis, each becoming progressively less distinct after the fourth.

The skin between the first and second chevrons is unmarked silvery gray, becoming pale cream away from the nuchal crest. After the second chevron, from the rear edge of each dark band the flanks are pale bluish gray, heavily mottled with dark gray. The mottling gives way to a series of discrete small pale cream spots, close to (but not usually in contact with) the front edge of the next chevron.

Along the back, the chevrons connect to an alternating pattern of near-black and pale cream spots down the middorsal line, marking where the dorsal crest will emerge. The cream spots begin as a single pale nuchal crest scale between the first and second chevrons, followed by three progressively larger spots to the third chevron, two large spots to the fourth, and a single spot between subsequent chevrons. Black scales between these spots



Newly hatched *Cyclura lewisi*: at this age the hatchling is still consuming its yolk sac and has not started feeding.

are continuous with chevrons, where those occur, and otherwise form isolated dark spots. This complex arrangement creates a bold alternating pattern down the middorsal line.

The series of cream spots continues onto the tail, merging into an alternating series of narrow pale cream bands and broad dark gray bands around the upper two-thirds of the tail. The end of the tail is almost black.

The legs have extensive cream mottling and pale bluish gray flecks on a dark gray base, with distinct cream spots particularly

evident on the rear legs and feet. Pale cream spots extend onto the toes, where they coincide with the joints, making the toes on both front and rear feet appear banded. The underside of the abdomen is silvery gray with the pale, fragmented ends of the strongest chevrons from each side almost meeting beneath.

By one year of age, the bluish gray and gray base colors have become clear blue and the chevrons have begun to erode, narrowing and breaking up into spots on the lower flanks, where they may become circles exposing a center of blue. The back is



Spots on the legs, still evident at one year, usually disappear completely as the animal ages.



Adult female *C. lewisi*: juvenile markings have been lost.

speckled with isolated pale cream scales and the flanks between chevrons are still marked with diffuse pale cream spots. The blue base color is progressively obscured by dark gray on the tail, where the banding becomes less distinct with age. The alternating cream and black pattern on the dorsal crest is reduced but still evident.

The juvenile pattern changes to the adult form gradually, by further replacement of cream spots and speckling with the blue base color and the variable loss of the dark chevrons (some adults lose them entirely). Limbs also become blue, apart from the toes, which lose all banding and darken to black. The nuchal and dorsal crest scales all become bright blue, with no trace of the juvenile pattern. The lower half of the tail becomes darker, with banding either totally obscured or very indistinct. The sclera of the eye becomes redder and more exposed as the animal grows.

Having said all of that, a Blue Iguana is only blue when it wants to be blue. All that blue is masked in dark gray when an iguana is cold, sleeping, or just trying to remain inconspicuous. The gray color closely matches the surrounding carbonate karst rock, on which iguanas seem to vanish into the landscape.

Watching these iguanas in the wild, they appear to use their color selectively and carefully, as signals to each other. In the greens and earth tones of Grand Cayman's dry shrublands, the bright blue of *C. lewisi* shines out like a beacon.

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SPECIES PROFILE

Ground Boas (*Tropidophis*) of the Cayman Islands

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Photographs by the author.

Compared to their relatives in the families Boidae and Pythonidae, the Ground Boas of the genus *Tropidophis* (Family Tropidophiidae) are relatively small and are sometimes referred to as “dwarf boas.” The largest species reaches a total length of barely over a meter and the smallest less than a third of that length. Unlike most boas and pythons, Ground Boas lack infrared sensors in interlabial pits, but, like their larger relatives, they possess vestiges of hind limbs, which are visible externally as a pair of cloacal spurs. All are live-bearers. They are ground-dwelling or semiarboreal and feed primarily on small vertebrates, mainly frogs and lizards. When disturbed, these snakes may exhibit autohemorrhaging from the eyes and mouth as well as cloacal discharge. On loose substrates, at least one species is known to employ sidewinding locomotion. Many (maybe all) species also are capable of physiological color changes, a phenomenon that is rare in snakes. Ground Boas apparently are unique among those snakes that can change colors in that they do so on a 24-hour cycle: they are lighter in color at night and darker during the day. All members of the genus are listed in CITES Appendix II and are rarely seen in the pet trade.

Species of *Tropidophis* are relatively broadly distributed in the West Indies and South America, but they are secretive. Consequently, many are not well-represented in museum collections and their taxonomy has been poorly understood. Previous



Adult Grand Cayman Ground Boa, *Tropidophis caymanensis*.



Subadult Little Cayman Ground Boa, *Tropidophis parkeri*.



classifications recognized 13–16 species, but a recent taxonomic study conducted by S. Blair Hedges elevated several subspecies to species rank and recognized 29 species. Three of these occur only in South America (Ecuador, Brazil, and Perú) and one is known only from a single specimen. The remaining 26 species occur in the West Indies, where most are restricted to single islands. Fifteen species are found in Cuba, and only in Cuba are the geographic ranges of multiple species (4–6 species, depending on the locality) known to overlap. Three species occur in Jamaica, two in the Bahamas, and one each on Hispaniola, Navassa, the Turks & Caicos Islands, Grand Cayman, Little Cayman, and Cayman Brac.

The local common name for the Ground Boas of the Cayman Islands is “lazy snake.” The name is derived from their habit of balling up when first captured rather than trying to escape. This behavior is widespread within the genus and is most likely to be exhibited by juveniles. The three Caymanian species were, until recently, considered to be subspecies of *T. caymanensis*, each endemic (restricted) to a single island. Each is now considered a full species: *T. caymanensis* (Grand Cayman), *T. parkeri* (Cayman Brac), and *T. schwartzi* (Little Cayman). All three are relatively small snakes, usually less than 50 cm in total length.

In the Cayman Islands, Ground Boas are primarily active at night and, on Grand Cayman, Grant found them to be especially active late in the summer following periods of rain. Ground Boas may occur throughout Grand Cayman and Little Cayman, but on Cayman Brac they appear to be limited in distribution to the northern and western coastal areas. Most are found on the ground, but exceptions exist: they have been found in the leaf bases of epiphytes and Richard Thomas found one 2.4 m above the ground in the roof of an outhouse! They have been found in habitats ranging from beach to dry forest and in leaf litter, rotten tree stumps, cracks in the walls of houses, and under palm fronds, rocks, slabs of limestone, logs, and boards. The diet seems to consist mainly of lizards of the genus *Anolis* and Cuban Tree Frogs, *Osteopilus septentrionalis*. The ends of the tails of Caymanian

Ground Boas are white to yellow in color, in stark contrast to the darker coloration of the rest of the snake. This pattern is usually seen in sit-in-wait (ambush) predators. As a snake lies quietly in wait, it wiggles the tip of its tail. This may attract the attention of a sight predator, like an anole or tree frog, that mistakes it for something to eat and ends up being eaten by the snake.

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SPECIES PROFILE

Saw-scaled Curlytail (*Leiocephalus carinatus*)

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Photographs by John Binns.

Curlytail Lizards (Genus *Leiocephalus*) occur in the Bahamas, Turks & Caicos Islands, Swan Island (in the western Caribbean), Cayman Islands, Cuba, and Hispaniola. Extinct forms are known from Navassa (situated between Jamaica and Hispaniola) and Martinique (in the Lesser Antilles). The Saw-scaled Curlytail (*L. carinatus*) is widespread in the Bahamas and on Cuba, with additional populations on Swan Island and the Cayman Islands. Thirteen subspecies are currently recognized, suggesting that such a widely distributed form comprised of many insular populations may actually represent a species complex.



Although males are highly territorial, home ranges of several females may overlap with that of a single male.



Individuals usually are quite wary and closely watch any potential threat. If approached too closely, lizards quickly retreat into burrows or crevices.

Leiocephalus carinatus varius occurs on Swan Island and Grand Cayman Island, whereas *L. c. granti* is abundant on Little Cayman Island and on Cayman Brac. Like others in the complex, these are large Curlytails. Although males are larger than females, individuals of both sexes can exceed 100 mm snout-vent lengths (SVL), with the largest males approaching 130 mm SVL.

Like other Curlytails, these lizards are exclusively diurnal, tolerant of hot, dry conditions, and often extremely wary. Their habit of curling their tails like a watchspring over their backs led to the Cuban common name, *perrito* (= little dog). Caymanian populations are primarily coastal and individuals are locally common on beaches where resources (food and shelter) are abundant.

Males are aggressively territorial and will fight savagely when behavioral displays involving lateral presentations, head bobbing, strutting, and inflating the sides of their necks fail to discourage an interloper. The home ranges of several females may overlap with that of a single male.

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Leiocephalus carinatus scavenging a dead fish on Little Cayman Island. Curlytail diets have been described as "catholic," and they quite willingly consume buds, flowers, seeds, and fruits of many plants along with a variety of small invertebrate prey. They regularly scavenge and may become quite tame in situations where they are fed or can forage on abundant food scraps. Large males in at least some populations of some species are cannibalistic.



Green Iguanas (*Iguana iguana*) have become a common sight in the human-altered habitats of southern Florida. *Photograph by Joe Wasilewski.*



A young Green Iguana from Miami, Miami-Dade County.



The southern Florida Peninsula. *Illustration by John Binns.*

Colonization Success by Green Iguanas in Florida

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Photographs by Richard D. Bartlett unless otherwise indicated.

If the business of biology is detective work, then answering the following questions is an attractive endeavor: Why is the Green Iguana (*Iguana iguana*) suddenly so ubiquitous in southern Florida? What can we expect of it in the future? Why? From an academic perspective, the Green Iguana and its relatives, the Spiny-tailed Iguanas (*Ctenosaura* spp., see IGUANA 10:111–118), are the only exclusively herbivorous components of Florida's exotic terrestrial herpetofauna. As a matter of aesthetics, the sight of an adult Green Iguana is an eyestopper. Also, these lizards are popular pets that can grow to large size, are

behaviorally complicated, can be docile, and are attractive. Not surprisingly, pet trade-related releases and escapes are responsible for the mostly spotty geographic distribution of Green Iguanas in southern mainland Florida and the Florida Keys. First reported from several sites during the 1960s, breeding populations were not confirmed until sometime later.

Where are Green Iguanas Now?

Presently, Green Iguanas are a largely coastal species in southern Florida. They occur somewhat continuously along the coast of



An adult Green Iguana basking on a palm with the Miami suburbs in the background. *Photograph by Joe Wasilewski.*



An adult male Green Iguana at Crandon Park, Miami-Dade County.

Palm Beach, Broward, and Miami-Dade counties and on Key Largo in Monroe County. Populations also are established on the lower Florida Keys. To the west, Green Iguanas are established in parts of Collier County and have been reported from Lee County. With some regularity, the species is seen in Vero Beach (Indian River County) and Tampa Bay (Hillsborough County). Although not part of breeding populations in the much colder interior of Florida, an individual was reported from Alachua County and another was seen in Highlands County. Apart from those in southern Florida, adults and hatchlings are known to occur in Cameron County in southern Texas.

Green Iguana populations reach their highest densities along the warm coast, where frost-free conditions prevail through most of Palm Beach County. Almost without exception, these lizards are associated with water, such as bays, canals, ponds, and ditches — and they are especially attracted to areas with trees that extend over water and where tender edible vegetation is abundant.

Population densities can be high. For example, annual reports from the Florida Department of Environmental Protection revealed that, at Cape Florida in Miami-Dade County, an astonishing 397 individuals were removed during the five-year period 1 July 1998–30 June 2003 (0, 0, 1, 12, and 384, respectively). During this same period, 27 individuals (5, 0, 0, 18, and 4, respectively) were removed from Hugh Taylor Birch State Park in Broward County.

At Oleta River State Park in North Miami (Miami-Dade County), Park Service Specialist Laura L. Kruger began seeing iguanas within a few years of her arrival at the park in 1998 and



An adult Green Iguana basking at the Kampong, Miami-Dade County.



An adult Green Iguana very comfortable in brush in Broward County.

has noticed a sizeable increase in population numbers. In the past three years, she has personally captured 16 individuals. She usually sees lizards in areas surrounded by saltwater habitat and in the park's mangrove stands.

At Fairchild Tropical Garden, also in Miami-Dade County, population densities are such that Skip Snow, National Park Service, has indicated that the Hibiscus garden can no longer be maintained. Although not sampled in similar fashion, these examples and our own combined observations at these sites and at others over time corroborate the notion of sharply increasing iguana population sizes at the few sites where anyone is monitoring the situation.

Temporal and Spatial Colonization Patterns

Why have Green Iguanas so suddenly become ubiquitous in an otherwise unremarkable Florida range? Efforts to separate the phenomena of increased interest in finding the species and increased dispersal rates (natural or otherwise) complicate the matter of dating newer populations. Acquiring a full accounting of which colonies are actually new and which were simply overlooked for some period verges on the impossible. If one examines the literature concerning this species in Florida, verifiable populations tend to be found far more frequently in a few southern-most counties than in new counties. With the exception of Palm Beach County, much of what Green Iguanas appear to be doing is filling gaps in their current distribution. What can be said with certainty, however, is that population growth in previously known sites dramatically increases the opportunities for natural

dispersal, especially along the seemingly innumerable waterways that crisscross the state.

Why, however, do increases in population sizes continue and how can one explain the sudden and seemingly endless supply of Green Iguanas from sites that had never supported large numbers during the 10 or so years during which we have been conducting searches? More directly and ironically, how has this species become so numerous that these former discards from the pet trade are now collected from south-Florida populations for sale by pet dealers?

The answers to these questions potentially can serve to predict the nature of future trends. Green Iguanas, like many other colonizing species, often occupy a few localized sites for very long periods while slowly building up population sizes or until conditions are ripe for an explosion of numbers, with the latter scenario ranging from nearly instantaneous to a period of many years.

Why populations persist initially requires a favorable combination of characteristics, all of which are present in southern Florida (in no particular order): (1) Amenable climate exists. (2) Disturbances in association with water are common in Florida, occur in many forms, and are often accompanied by prolific growth of ornamental or native edible foliage. Perhaps these habitat characteristics mimic the secondary growth along rivers so favored by Green Iguanas in native ranges throughout the Neotropics? (3) Competitors for food, except other Green Iguanas, are largely absent. (4) Adults are safe from most predators, and potential predators of hatchlings and juveniles are uncommon in human-disturbed situations. (5) Green Iguanas



A young Green Iguana from Miami, Miami-Dade County.

are either protected by humans who like them or are hard to detect by residents who do not. (6) These lizards can persist for long periods until conditions are favorable for recruitment; although attaining maturity may take three to four years, females then can produce large clutches for many years.

To illustrate the resilience of iguanas, in 1999, one of us received an adult female that had been collected in downtown Austin, Texas. According to the collector, she had been living for at least three years in a burrow (possibly of her own construction) in an extensive area of rubble from a demolished building and highway construction. Low, weedy shrubs of unknown species grew thickly around the perimeter. On many occasions, this iguana had been seen eating foliage and blossoms from the shrubs. When crews began removing the rubble, they decided to catch the iguana. Except for having her elongated vertebral scales worn completely off, this 3-foot long iguana was in excellent condition and acclimated immediately to captive conditions. Today, five years after being captured, her vertebral scales have regrown only moderately.

Back to Florida, on Virginia Key, Biscayne Key, Cutler Bay, and in Hugh Taylor Birch State Park, Green Iguanas were not nearly as abundant before Hurricane Andrew in 1992. With the exception of Hugh Taylor Birch, they had been present for many years at these sites — but in no appreciable numbers. Within a decade subsequent to Hurricane Andrew, the Green Iguana bucket, so to speak, began to overflow. Common to these sites (with the exception of Hugh Taylor Birch) was aggressive replanting with a smorgasbord of plants, shrubs, and trees bearing edible and apparently delectable parts. Abundant resources in a rich

habitat resulted in successful reproduction and a large crop of now 8+ year old adult females that are in turn producing large numbers of hatchlings each year. This surplus is now large enough to disperse actively to previously vacant areas that also were heavily planted after the storm. However startling the population densities, as both herbivores and ectotherms (which require far less energy for maintenance and reproduction than endothermic birds or mammals), large body size is no barrier to



A sick Green Iguana on a lawn in Miami, Miami-Dade County. Although no cause is known for the condition of this individual, feral iguanas may be vulnerable to toxins used to control pests or weeds.

enormous population densities, despite what might superficially seem like a mediocre food supply.

Further accelerating geographic expansion attributable to explosions in population sizes is the ever-increasing potential for pet escapes or releases. Within the past decade, farming of iguanas for import into this country from several Latin American countries, especially Colombia and Belize, has reached levels such that tens of thousands of baby Green Iguanas are introduced via the pet trade each year — and continuously rather than seasonally as in the past. This has resulted in close to single-digit retail prices. With this explosion in availability has come a concurrent spike in orphan iguanas, enhancing opportunities for escapes or deliberate releases of unwanted pets that have become too large, too aggressive, or too sick to keep.

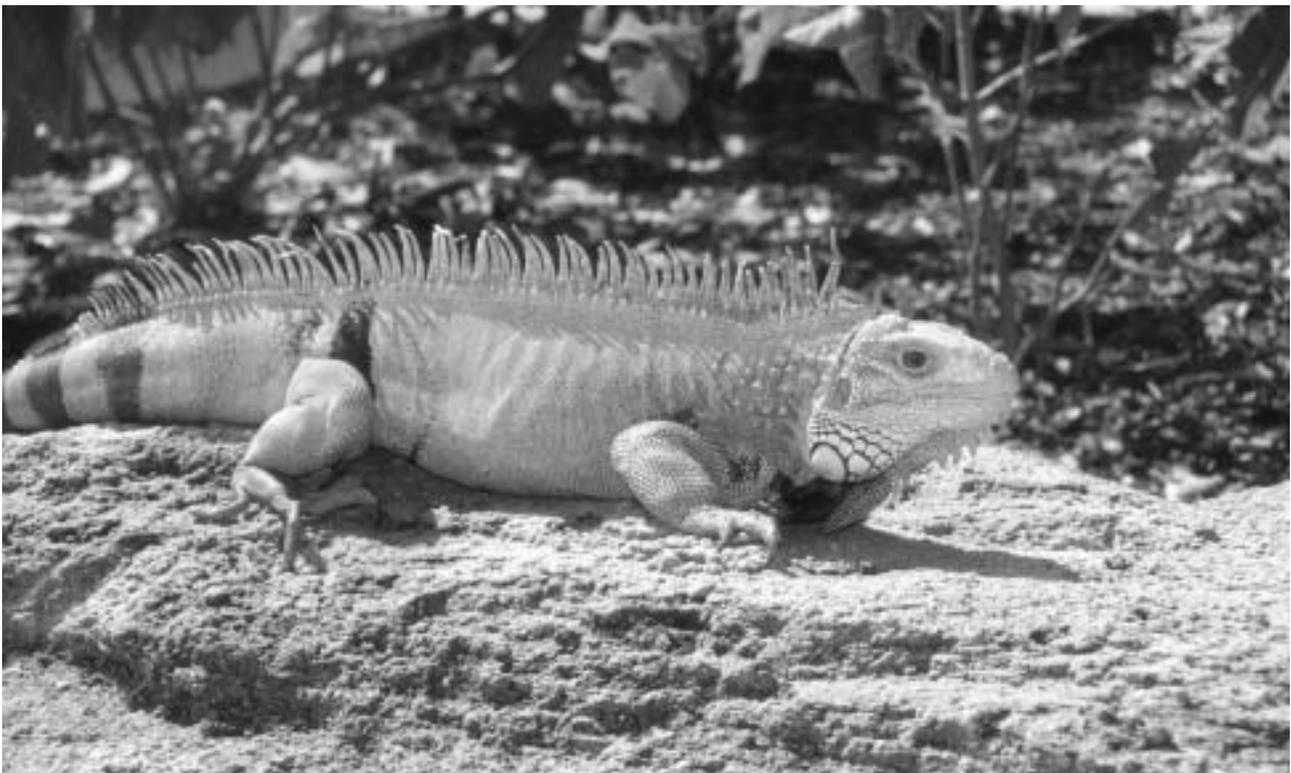
The Test

So, Green Iguanas are thriving in their disturbed southern Florida range. Yet, the exception tests the rule. Everglades National Park, a large expanse of relatively natural wetland and upland communities, provides the test. The Park also was damaged by Hurricane Andrew, but was then left to revegetate on its own. Since 1970, the Park has reported only 20 sightings of Green Iguanas, with observations occurring in 1970–1977 ($N = 11$) and again in 1995–2004 ($N = 9$). Reports occurred on or very near heavily traversed trails, along canals, or in campgrounds. In all cases, animals were near or very near water. Mean estimated total length of these individuals was 94.3 ± 19.4 cm (61.0–121.9 cm, $N = 16$), with size estimates not available in four instances.

Could the second wave of reports corroborate the notion of a human-mediated boom in the Green Iguana population after

Hurricane Andrew, now spilling into the Park? Of the nine reports during 1995–2004, all but two came from the north end of the Park or in association with adjoining canals. The exceptions were a single individual found along the road just north of the West Lake boat ramp and boardwalk and a single individual found in the Flamingo campground; both likely locations for vehicle-related dispersal from other locations. Reasons for the first pulse of sightings in the 1970s and the subsequent hiatus in the 1980s are unknown, but the opportunity for Green Iguanas to disperse into the Park appears to have increased since the nearly 20 year hiatus in sightings. This phenomenon is most easily explained by connections to the Park via canals that pass through Florida City and Homestead, both of which most certainly sustain populations, and by the post-Hurricane Andrew boom in quality habitat. Yet, despite the increased opportunities for dispersal into the Park, both pulses of sightings represent failed colonization attempts with no evidence of successful reproduction. We suggest that the reason for this failure is because the Park is, in many ways, what urban and suburban southern Florida is not — namely natural habitat occupied by a suite of well-adapted native predators and potential competitors.

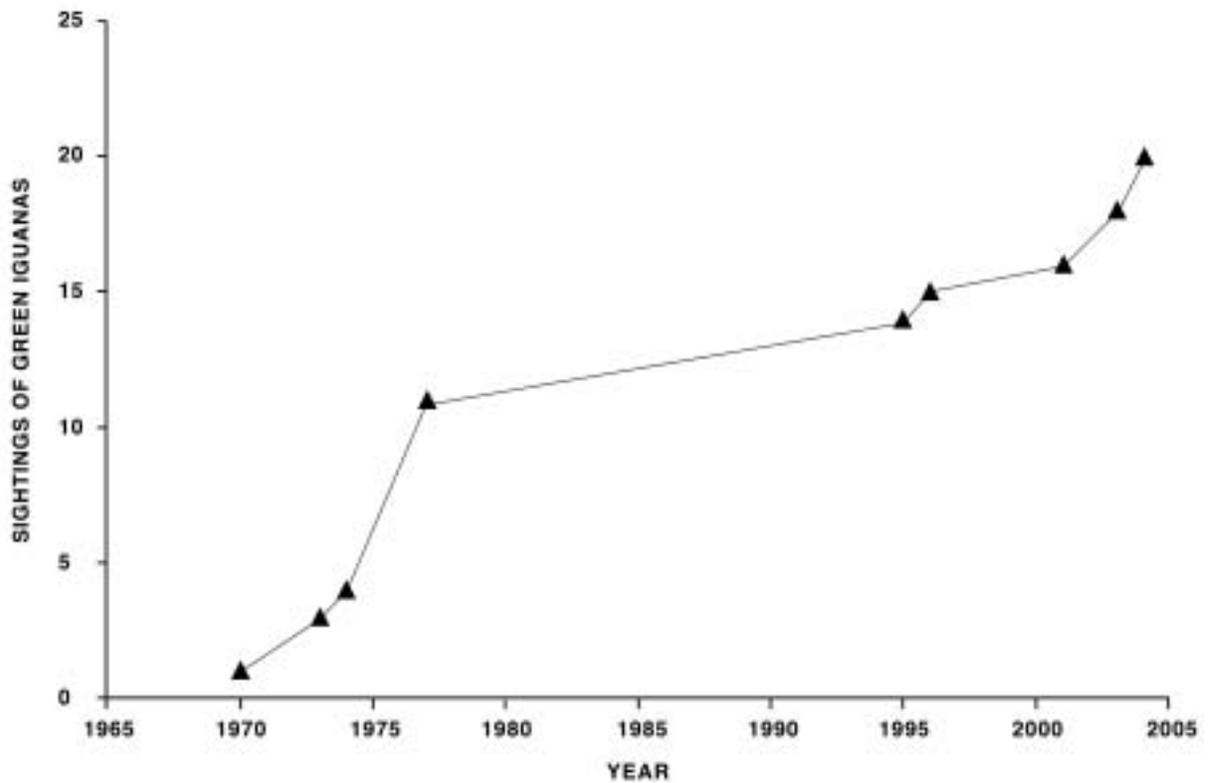
In sharp contrast to the nearly ideal conditions experienced by Green Iguanas in the developed areas of Miami-Dade County, the Park has an abundance of predators (including the American Crocodile, a known predator of iguanas), a dearth of suitable fully-insolated nesting sites in areas of open-canopy and well-drained soils, and a food supply that is less than ideal for iguanas, which prefer the more palatable ornamentals so beloved by South Floridians. As long as human intervention with the Park's watershed does not alter any of these three factors in any substantive



South Floridians often encounter feral Green Iguanas basking in open areas. *Photograph by Joe Wasilewski.*



Geographic distribution of Green Iguanas (*Iguana iguana*) in Florida. Only those counties with established colonies are indicated; Highlands and Alachua counties are not shaded because those records appear to represent waifs.



An accumulation curve of sightings of Green Iguanas in Everglades National Park from 1970–2004.



Green Iguanas using arboreal perches may be difficult to see, explaining why few area citizens are aware of their growing numbers, especially in urban and suburban yards and parks. *Photograph by Joe Wasilewski.*

fashion, the southern Everglades should continue to resist colonization by iguanas.

The Future?

Urban and suburban areas of southern Florida effectively provide a glimpse of the not-too-distant future, when continued growth of the human population and the inevitable alterations of the few remaining natural areas will assure that Green Iguanas will mimic the exceedingly successful Brown Basilisk (*Basiliscus vittatus*), which has already become an ubiquitous inhabitant of waterside properties, but is held in check solely by penetrating frosts in regions to the north. For Green Iguanas, this translates into a secure coastal existence north to Martin County along the eastern coast and to near Sarasota, Sarasota County, on the west. Why? Because human-mediated changes will increase opportunities for lizards to disperse, the number of wayward pets will increase. Also, the climate is largely amenable and further habitat modifications to their liking are likely. Iguanas are innately highly fecund, and, with few exceptions, human attitudes regarding their presence range largely from indifference to enjoyment. Only in the ever-shrinking natural areas of the state does the Green Iguana seem ill-suited.

As for every other of the 40 exotic species of amphibians and reptiles that are successfully reproducing in Florida, humans are the cause of the Green Iguana's very existence in Florida and their subsequent success. The evident prosperity of this large herbivore effectively underscores the huge role humans can, even if inadvertently, play in the good life enjoyed by so many exotic species in the hospitable climes of southern Florida.

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SPECIES PROFILE

Species Profile: The Knight Anole, *Anolis equestris*, in Southern Florida

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The Knight Anole, *Anolis equestris*, is a most fascinating lizard. Endemic to Cuba, where it is widely distributed, the species has been in Florida for half a century. There, it has become an ubiquitous member of southern Florida's exotic herpetofaunal community. Ecologically, this species stands out as a very un-anole-like anole. It is very large, the largest species in the genus, reaching nearly 60 cm in total length. It is omnivorous. It sits and waits for prey or actively forages for invertebrates, small vertebrates, and the tender foliage and fruits of various plants. The texture of its skin is far more similar to a chameleon-like suede

than the typical dry and sandy feel of most other anoles. Likewise, its eyes, casqued head, and careful movements are more like those of the true chameleons (*Chameleo* spp.) or its ancient Cuban relatives (anoles formerly placed in the genus *Chameleolis*) than those of the more evolutionarily derived anoles with which it shares its home in southern Florida. These lizards' odd outlines, exacerbated by the prominent head casques, the broken and variable color patterns dominated by greens of various hues, and their often deliberate style of movement causes them to be easily overlooked by friends and foes alike.



A rather odd profile, exacerbated by a prominent head casque, plus the broken and variable color patterns dominated by greens of various hues render these lizards very cryptic despite their large size. *Photograph by Joe Burgess.*



These large anoles are most frequently seen when they bask on trunks of trees. *Photograph by Joe Burgess.*

Because of its role as a large, successful predator and the fact that it utilizes arboreal habitats that overlap with those used by the anoles it often eats, Knight Anoles are likely to be a major force in shaping the anoline assemblage of southern Florida, much of which consists of introduced species, mostly from Caribbean islands. Orlando Garrido, an eminent Cuban herpetologist, once predicted, for example, that Cuban Green Anoles (*Anolis porcatus*) would never successfully colonize southern Florida, mainly because Knight Anoles, which routinely eat their smaller relatives, were so abundant. That the Cuban Green Anoles have apparently succeeded attests more to the abundance of cover in the dense groves of ornamental plants that characterize most urban and suburban communities in southern Florida than to any deficiency of Knight Anoles as predators.

From the standpoint of a colonizing species, much remains to be studied, but Knight Anoles appear to follow closely the pattern seen in Florida's Green Iguanas and many other species of introduced amphibians and reptiles: they are abundant human commensals with enviable reproductive potential and which are eminently capable of taking full advantage of the artificially lush habitats of southern and especially coastal Florida.

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These lizards are striking and cryptic at the same time. *Photograph by Walter E. Meshaka, Jr.*

Both Friend and Food: The Conservation of Iguanas in Panama's Market Economy

Darrin DuFord
New York, New York

Green Iguanas wear many hats. These unassuming reptiles play roles as tourist attractions, pets, and endangered species. However, their role as the main course for dinner ironically is providing Panama with a vehicle for the species' conservation.

Iguanas have appeared on menus in Central America for thousands of years, but the species' existence only began to be threatened over the last century as a consequence of excessive hunting and destruction of its habitat to make room for cattle and other agricultural cogs in a cash economy. However, scarcity hasn't quelled the Panamanian's traditional practice of entering

the forest with a slingshot and leaving with a "free-range" iguana. With high protein and low fat content, iguanas, which are herbivores, have provided many a family with a fresh, healthy, natural meal. Iguana eggs, a rich, creamy treat, allegedly cure various ailments, once one finds a way through the tough, leathery shells.

Balancing the conservation of a species, a regular supply of a customary meal, and income for farmers has never been a simple task. In the 1980s, biologist Dagmar Werner tackled the complex challenge by launching a project in Panama to evaluate the viability of raising iguanas in captivity for food and profit. She



After hatching in a secure pen, baby Green Iguanas at the Río Cabuya iguana farming project are transferred to an elevated cage (shown here), where they will remain, safe from predators, until they reach six months of age. The fabrication of the cage has an intentionally improvised appearance to mimic the availability of whatever building supplies may be lying around any farm in Panama. *Photograph by the author.*

soon moved her operation to nearby Costa Rica in order to take advantage of a more nurturing political and economic climate. Despite initial successes, however, the Costa Rican project, including a restaurant serving iguana burgers to promote its cause, recently and unexpectedly closed its doors.

Today, Panama is giving the idea a second chance. Nestled in a park in the watershed of the Panama Canal, scientists at the 60-hectare Rio Cabuya Agroforestry Farm have been spearheading a program to teach campesinos how to raise their own iguanas as a sustainable food source. While profits are understandably on the minds of the participating farmers, the primary goal of the project, at least at first, is to keep the campesinos from hunting the threatened creature in the wild.

While poaching wild iguanas is illegal in Panama, little government-funded monitoring actually occurs — and conservationists in Panama have frequently encountered impediments. This lack of oversight triggered a recent decision by the Convention on International Trade in Endangered Species (CITES) that recommends sanctions on all of Panama's CITES-listed exports of both flora and fauna, explicitly due to the government's failure to adopt legislation protecting the country's species in danger of extinction.

Even at the agroforestry site itself, setbacks occur. "Poachers sometimes raid the park and steal a few of our iguanas," explained ANCON Expedition's Rick Morales, as we followed the life cycle of iguanas hatched and raised in the ground's caged housing. The facilities appeared modest and improvised — intentionally — to mimic the availability of whatever building supplies may be lying around any farm in Panama: scrap sheet metal, chicken wire, and spare lumber.

The idea is simple. The project lends campesinos a pair of adult iguanas at no cost, and provides tutelage on housing, guarding, and feeding them. In protective captivity, around 95% of the 35 or so eggs per clutch will survive. This stands in stark contrast to the about 5% success rate in the wild, where eggs helplessly succumb to the hunger of ants, snakes, and other natural predators. At six months, adolescent iguanas, virtually predator-free, are either released into the campesinos' trees for future easy-access meals, or they are kept in a larger shelter. After 18 months, the campesinos can swap their breeding iguanas for another pair.

To uphold their end of the deal, the campesinos must return twenty percent of the iguanas to the wild. They can sell or eat the rest. The mathematics, in principle, tell us that the forest gains more of a threatened species, the campesinos gain the opportunity to legally eat a traditional meal without hunting in the wild; and only the snakes lose (but don't worry; snakes still have plenty to eat).

So, how successful has the project been? Our search for answers led Rick and me to the office of ANCON biologist Augusto Gonzalez, who, for the past twelve years, has been managing the iguana-farming project. According to Gonzalez, the accomplishments of the project varied with the diverse Panamanian geography. "So far, in the Canal watershed area, the participating farms have achieved little," he conceded. Whereas iguanas are threatened throughout Panama, populations in various provinces have been unevenly affected, following uneven patterns of hunting and deforestation. In the watershed of the Panama Canal, the iguana population has suffered less than in



The author inspects a juvenile Green Iguana that, in two years' time, will be lent, along with husbandry technology and an iguana of the opposite sex, to a Panamanian farmer so the farmer can establish his own legal iguana ranch. The farmer must return twenty percent of the adolescent hatchlings to the wild, and can eat or sell the rest. *Photograph by Rick Morales.*

other parts of the country, hence the watershed's campesinos do not want to pay for feeding and raising something that they can readily — albeit illegally — catch for free in the wild.

Some iguana farms backfired. A few would-be iguana ranchers, in the course of protecting and raising the creatures, found the iguana's curtain-like dewlaps and distinguished stares too endearing to eat them, even extending the attachment by giving the creatures names. Those campesinos could not bear releasing the reptiles into a bordering tree, lest "Paquito" end up on a skewer over a neighbor's barbecue pit.

The arboreal behavior of Green Iguanas has been both a blessing and a curse to the program. An iguana likes to stake out one tree and claim it as its home and territory, where it basks and feeds, so campesinos do not have to worry about their investment scampering off deep into the forest. Also, although iguanas grow faster if released into trees, the practice leads to a few other problems. If the trees are too near crops — a typical scenario if the trees are used as buffers in between crops to prevent erosion — iguanas may not be able to resist feasting on the readily available buffet. Worse yet, if the trees border a neighbor's farm, the iguanas might just eat the neighbor's profits.

Why not keep them in large pens? Food, then, becomes an expense, as opposed to iguanas released into fruit trees, which require no feeding, since they take care of themselves by munching on treetop leaves, mangoes, and papayas at their leisure. The

tree-dwelling iguanas still leave fruit for the campesino, although for heavy stocking of trees, some supplemental feeding is required. Caged iguanas also take longer to reach “harvesting” weight — to five years for a five-pound iguana that is able to feed a family of four or five. Many campesinos concerned with making ends meet week to week simply cannot wait that long to spoon up that iguana stew.

The culinary climate is completely different in the central provinces of Panama. Since the campesinos of Coclé and Southern Veraguas have virtually wiped iguanas out of the region, they were much more willing to participate in the project. Gonzalez nodded with satisfaction as he informed me that 100 iguana farmers in the central provinces have been enjoying the project for years. Well-run iguana farms can yield 300 kg of meat per year per hectare — that’s five to ten times as productive as raising cattle on the same land — with the added benefit that, with a “herd” of iguanas, the erosion-fighting trees remain standing. Some farmers utilize a mixed system, in which they still raise other livestock and grow other crops while keeping iguanas in a caged shelter, providing a diverse yield. Other farmers have even profitably sold some iguana meat to their neighbors (presently, technological and political barriers preclude the realization of large profits from iguana farming, preventing the practice from becoming more popular). Still others enjoy raising them for fun. The species itself has shared in the program’s rewards as well; thus far, over 10,000 iguanas have been returned to the wilds of Panama.

As an added benefit, iguanas also can provide a reason to keep trees on one’s property and help preserve the remaining tropical forests. In 1850, 92% of Panama was covered by forest. By 1986, the percentage had been reduced to 37%, almost entirely due to the voracious needs of short-term profit farming. When farmers clear a plot of tropical land using the slash and burn technique — still a common sight (and smell) in many parts of Panama — the poor tropical soil provides a bountiful



Diner or dinner? A curious Green Iguana looks up from foraging in a Panamanian forest. Due to overhunting and the ongoing destruction of habitat from extensive farming, Green Iguanas are a protected species in Panama. *Photograph courtesy of ANCON.*

crop for one or two years, owing to the nutrients in the burned material. Soon after, however, the plot becomes a desiccated wasteland that often requires twenty years before it is reclaimed by forest. Long before then, the farmer has moved on to another plot. If large swatches of land were cleared using this technique, the area may risk becoming a desert. Since the forest is not only the habitat of the iguana, but thousands of other plants and animals, the action of preserving tropical forest, in effect, preserves the entire ecosystem.

Of course, believing that the Green Iguana can provide the lizardly linchpin capable of holding together the Western Hemisphere’s tropical ecosystems would be naïve. After all, humans must make the choice to balance their needs and those of the environment. However, thanks to the Green Iguana, conservation has never been so delectable.

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Disappearing Treasures: National Association for the Conservation of Nature (ANCON) Biologist Augusto Gonzalez (right) examines adult iguanas captured from their Panamanian habitat. Gonzalez manages a project encouraging farmers who eat Green Iguanas to raise the iguanas in captivity and semi-captivity instead of hunting them in the wild, as the creature’s numbers in the wild are decreasing. *Photograph courtesy of ANCON.*

The following webpage also may be helpful: Melissa Kaplan’s Green Iguana Care Collection (<http://www.anapsid.org/iguana/index.html>).

S P E C I E S P R O F I L E

The Mangrove Treeboa (*Corallus ruschenbergerii*)

Robert W. Henderson

Milwaukee Public Museum

The Neotropical treeboa genus *Corallus* is currently comprised of six species with mainland distributions from Guatemala to southeastern Brazil, including insular populations off Brazil, Venezuela, and Panama. Two additional species occur in the West Indies on the St. Vincent and Grenada banks.

The two largest of the eight species are the Emerald Treeboa (*Corallus caninus*) and the Mangrove (or Caribbean Coastal) Treeboa (*Corallus ruschenbergerii*). *Corallus caninus* has a broad distribution in the Amazon basin and the Guianas. *Corallus ruschenbergerii* has a more limited range from southern Costa Rica, through Panama, and into northern Colombia, northern Venezuela (including Isla Margarita), and Trinidad and Tobago. These snakes probably do not occur sympatrically (or syntopically) with *C. caninus*. This species is probably the longest of the treeboas with a total length reaching or surpassing 2.5 m.

Corallus ruschenbergerii exhibits a wide range of dorsal coloration, including dingy yellow, subdued shades of red, gray, and a variety of shades of brown. The dorsal pattern usually is composed of rhomboidal shapes, although this pattern is not always discernible.

Mangrove Treeboas are nocturnal and forage in trees and bushes. The boas forage actively by moving slowly through the vegetation with frequent tongue-flicks on leaf and branch surfaces, or they use a sit-and-wait (= ambush) strategy, wherein they assume a head-down posture and wait for prey to come to them. Younger (smaller) snakes use the active foraging mode and older (larger) individuals exhibit the ambush strategy. This coincides with an ontogenetic shift in diet from predominantly birds in smaller boas to one primarily of rodents (murids, including introduced *Mus* and *Rattus*) in large snakes. Bats are consumed occasionally, and *C. ruschenbergerii* from Costa Rica and Panama are known to eat Basilisk lizards (*Basiliscus* spp.).

Although the Mangrove Treeboa lives up to its common name and occurs in mangrove habitat in every country throughout its geographic range, it also lives in a variety of other habitats, including rainforest, gallery forest, and deciduous forest. It often is associated with water, and is particularly abundant along the shores of lakes, rivers, reservoirs, and marine coastal situations (Caribbean Sea). Like other members of the *Corallus hortulanus* complex (*C. cookii*, *C. grenadensis*, and *C. hortulanus*), all of which are typically inhabitants of edge habitat, Mangrove Treeboas are frequently encountered in highly disturbed situations such as road cuts and even around (and occasionally in) people's homes.

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A Mangrove Treeboa (*Corallus ruschenbergerii*). Photograph by Richard A. Sajdak.



Grand Cayman Blue Iguana "Godzilla" (~1934–2004).

Requiem for Godzilla

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Photographs by John Binns.

If you have ever had a family member that, against all odds, lived past their life expectancy, you may identify with the relationship the herpetological crew at the Gladys Porter Zoo had with Godzilla — the oldest living lizard on record. A giant of a Grand Cayman Blue Iguana (*Cyclura lewisi*), he measured over 50 cm from snout to vent. When he came to the Gladys Porter Zoo in 1997, he was estimated to be 62 years of age. He had a giant head, an enormous, yet gaunt body, and a senile cataract in one of his eyes. Despite his incredible appetite and his ability to consume large volumes of food, he never seemed to be able to gain or carry much weight — just like grandpa.

In March 2004, John Binns asked me to write an article on Godzilla, and I agreed. Although we have known for years that Godzilla's days were numbered, I had no clue this article would be written in eulogy (see also the inside back cover of *IGUANA* 11(2)). At approximately 69 years of age, Godzilla died in late May of this year from age-related liver failure. Based on the appearance of his internal organs, he looked and acted amazingly well until a week or so before his death. Blind in one eye and partially blind in the other, Godzilla had gotten a bit wobbly, and would sometimes tumble, rather than climb off his favorite basking spots. As he grew more and more senile, we watched with great compassion and respect. Godzilla had led a colorful and amazing life. His history tells volumes about the tenacity and resilience of both this individual animal and the world's most critically endangered iguana species.

West Indian Rock Iguanas of the genus *Cyclura* are, as a group, under severe threat throughout their range. As large island endemics with no adaptations to protect against mammalian predators and competitors, they are suffering catastrophic declines from dog, cat, and rat predation, hunting, habitat degradation by goats and cattle, and large scale habitat loss to human uses. The Grand Cayman Blue Iguana is the most endangered in the group, with an estimated 10–25 individuals surviving from the original wild population (see *Iguana Times* 9(3):51–58; 10(1):15–20; *IGUANA* 11(1):30–31).

The Gladys Porter Zoo is one of a handful of US facilities that have breeding programs for Grand Cayman Blue Iguanas. Most of the captive Blue Iguanas in North America are related to one another, making it very important to preserve the genetic material of those individuals, like Godzilla, that have not bred in captivity. US facilities work closely with officials on Grand Cayman to preserve what little habitat remains and support their efforts to build and maintain breeding facilities. Without the

dynamic efforts of the Grand Cayman National Trust (see the profile of Fred Burton, *IGUANA* 10(2):53–55), The International Iguana Foundation, many supporting members of the American Zoo and Aquarium Association, and dedicated iguana conservationists outside the zoo community, this species would already be past the point of no return. Hopefully, the combination of habitat protection, habitat restoration, and the release of captive-hatched iguanas in protected areas on Grand Cayman will ensure their existence for many years to come.

Godzilla was captured as a full-grown adult on Grand Cayman in 1950 by naturalist Ira Thompson. Godzilla weighed over 15 pounds and was estimated to be at least 15 years of age at that time. I was told that he was captured on Grand Cayman with a guava on a treble hook, and the hook split his upper lip. Although the lip healed, Godzilla was left with two fleshy protrusions on either side of his snout (these moustache-like protrusions, although surgically removable, were left alone, serving as permanent identifying marks). He was imported to the US in 1985 by Ramon Noegel of Life Fellowship in Florida. Although offered multiple opportunities to breed, according to Greg Moss, Godzilla was already showing signs of aging and never sired a fertile clutch of eggs. Ownership was transferred to Tom Crutchfield in the early 1990s.

Godzilla came to the Gladys Porter Zoo during late winter in 1997, along with three other Blue Iguanas, two males and one female. When the group arrived, many of the adults needed medical treatment to help them recover from the trip. Our first introduction to Godzilla's health problems came the day after his arrival. He was initially treated for a fungal infection in his gastrointestinal tract. Surprisingly, he responded rapidly to antibiotics and a giant dose of South Texas sunshine. Despite the presence of another large adult male that was much more athletic, Godzilla established the outside yard and night house facility as his territory, and never relinquished his dominant status.

Godzilla was one of only a few founding Grand Cayman Blue Iguanas in the US, and, having made no contribution to the captive gene pool, getting him to reproduce became a priority — well, right after keeping him alive. Just like any geriatric creature, something always seemed to be going on with his health. He would tear off a toenail, revealing clotting factor problems that required vitamin supplementation and bandaging. He had an intermittent sinus problem that occasionally required antibiotic administration. For some strange reason, he had periodic bouts of tail problems that would require the surgical removal of sev-

eral inches of his tail. We would beef him up with vitamins and medication for weeks prior to such a surgical procedure.

We have a saying at our reptile department: with herps, real medical emergencies are rare. However, this saying never applied to Godzilla and his injured toenails that refused to stop bleeding. Indeed, Godzilla routinely brought out the “hero” in our veterinary staff. He usually gratified us by bouncing back after his emergency treatments.

Unfortunately, the adult female that arrived with Godzilla in 1997 died of coelomitis secondary to chronic egg retention just four months after her receipt. In June 2000, a suitable potential mate for Godzilla was sent to us from the National Zoo in Washington. I knew our work was already cut out for us. She had been kept indoors and was cued to lay eggs in February. In February, the weather is still cold in Brownsville, and most of our *Cyclura* have historically laid eggs in June or July. I wondered how long Godzilla and the new female would take to get their reproductive cycles in-sync.

On a very warm day in April 2001, Dave Martin, Head Keeper of Reptiles, decided that the time had come to give the pair a try at breeding. Godzilla looked interested in the female, but she was much more nimble than he was, and always managed to scamper away from his advances. Neither Godzilla nor Dave was willing to give up easily, and Dave contrived an ingenious plan. He brought both of the animals into the confines of their barn and nighthouse in hopes that the female would not succeed in getting away. She didn't get away, but Dave said Godzilla seemed unwilling to breed indoors. So, the three of

them went outdoors. This time, Dave held the female's tail to keep her from running away. Again, Godzilla seemed interested, but possibly concerned about Dave's presence in his territory. Finally, Dave carried the female into the barn and crouched at the undersized door, constructed to allow the passage of iguanas — not humans. Holding the female's tail securely, he extended his arm and the female into the outdoor enclosure.

Success! Dave had made himself “invisible” enough to keep Godzilla from being intimidated. Godzilla approached the female and grabbed the skin of her nape. Figuring Godzilla had it handled, Dave let go of the female. However, when Godzilla would



Godzilla's species name changed three times during his estimated 69 years of life. He was captured as *Cyclura macleayi lewisi*, later became *Cyclura nubila lewisi*, and passed away as *Cyclura lewisi*. This photograph shows his distinct telltale “moustache.”



Although handicapped by the ravages of age, Godzilla remained as proud as any Blue Iguana many decades his junior. Shown here in his display area, Godzilla would pause frequently to rest while enjoying the warm Texas sun.



As Godzilla aged, he became increasingly unstable, often had difficulty reaching his favorite basking spot, and sometimes tumbled rather than climbed down. However, atop his basking spot, his proud stance seemed to say that age was irrelevant, and he remained a grand Grand Cayman Blue until the end.

try to readjust his grip, the female would scamper off. After several similar attempts, Dave figured he had nothing to lose and he did not let go of the female. Finally, with Dave's assistance, Godzilla copulated with the female. This was repeated a week later, with the same results.

No eggs were produced as the result of that breeding, and Dave got creative once again in 2002. On 6 May, Dave played matchmaker. This time, he learned that, if he maintained a low profile or remained partially hidden in the outdoor enclosure, Godzilla would tolerate his presence. Copulation this time was of much shorter duration.

When the female laid infertile eggs in July 2002, we suspected that mating had taken place too early in the reproductive cycle of the female — or Godzilla was infertile.

In the two years that followed, the matchmaking scheme was repeated, but Godzilla no longer showed any interest in breeding. The female continued to lay eggs each year in mid-July, but her eggs in 2003 and 2004 were infertile.

As each breeding season passed for Godzilla, we knew that he might not be around for the next. This was certainly so for the breeding season in 2004. Increasingly wobbly and uncoordinated, we watched him closely, although he continued to feed well when he could figure out where the food was. I discovered that I could place his food in the bottom of a five-gallon bucket, lay the bucket on its side and let him walk headfirst into the bucket. This became the most energy efficient way to feed an old lizard that could not see very well and tired easily when fed by hand.

In mid-May, we were treating Godzilla for an eye injury he had sustained after running into a gunnite wall, when we noticed how jaundiced the inside of his mouth looked. Blood work revealed an extremely low red blood cell count and our veterinarians suspected a failing liver. Almost as though he knew that his secret was out, Godzilla refused to eat from that day on. By the following day, he would not move in and out of the sun to thermoregulate and I brought him up to the reptile house. Two days later, wrapped in my favorite flannel snake bag, Godzilla died peacefully in his sleep. A quiet sadness fell over the Herpetarium that day.

Still, we had to move quickly to ship his gonads and tissue samples to the San Diego Zoo's Center for Reproduction of Endangered Species (CRES). Tandora Grant helped make the arrangements for the priority shipment that would result in the preservation of his precious genetic material. Two days after his passing, she informed us that he still had live sperm in his testes at the time of his death.

Histopathology reports confirmed severe age-related cirrhosis of the liver as the cause of death. The pathologist commented he had never been presented with such an old lizard. We were certain that was true.

Like the few remaining wild Grand Cayman Blue Iguanas, Godzilla was a trooper that fought the odds every day. All iguanas are unique and spectacular in their own right, but Godzilla was "perfect" — a favorite of zoo keepers and volunteers alike. He will truly be missed.

H U S B A N D R Y

Iguana Restraint and Handling

Jeff Lemm

Center for Reproduction of Endangered Species (CRES), Zoological Society of San Diego

Photographs by the author unless otherwise indicated.

In order to reduce the risk of injury to both animal and keeper, proper restraint techniques are necessary whenever iguanas are handled. Handling and restraint impose a tremendous amount of stress on an animal, and iguanas should be handled only when necessary (vet checks, weighing and measuring, etc.). In addition, keepers should do everything possible to reduce stress on cagemates that are not being captured. For instance, iguanas hiding in tubes or other hide areas should not be disturbed. Instead, the whole hide area should be moved when in pursuit of the desired animal. These same methods should be used with everyday cage maintenance. Captive animals may show signs of stress immediately following capture and these signs, which may last a few days, generally include appetite loss, constant hiding, and flight behavior.



Hatchling animals such as this Rhinoceros Iguana (*Cyclura cornuta*) can be handled by gently grasping the entire body. In some cases, the head can be held with two fingers to avoid potential bites.



Juvenile iguanas, such as this Anegada Iguana (*Cyclura pinguis*), can be held in similar fashion to hatchlings. Older juveniles may need to be held with two hands.

Because iguanas have both strong jaws and large, powerful claws, minor injuries to keepers are common. Even juvenile iguanas can inflict nasty bite wounds that often require stitches, and a bite from an adult iguana can be serious. Iguana scratches are common, especially from the long rear toes of an iguana's back legs. In addition, hatchling and juvenile iguanas may have their tails broken due to improper handling techniques.

Perhaps the easiest, least-stressful way to capture an animal from an enclosure is with a net. Large fishing nets, with the net



Smaller iguanas, especially individuals that are accustomed to handling, such as Fiji Iguanas (*Brachylophus* spp.) and Desert Iguanas (*Dipsosaurus* spp.) often sit in the hands of keepers. Animals that are more flighty can be grasped like juvenile *Cyclura*. In this photograph, the author is holding a Fijian Banded Iguana (*Brachylophus fasciatus*) and a Fijian Crested Iguana (*B. vitiensis*). Photographs by Mike Swan.



Chuckwallas (*Sauromalus* spp.) are best held with a firm grip around the body and may need to have the head restrained. Pictured here is a San Esteban Island Chuckwalla (*Sauromalus varius*).

replaced by a cloth bag, work well for this purpose. Netting rips easily and iguanas have the ability to break through the net and escape or they may become wrapped in the netting itself. Hand-grabbing or manually capturing iguanas works well with younger animals or larger, non-aggressive adults. Keep in mind that when cornered, some iguanas may become very agitated and some species may rush or jump toward the keeper with mouth agape.

Hatchling iguanas and smaller species (*Brachylophus*, *Dipsosaurus*, *Oplurus*, and *Sauromalus*) should be restrained in the middle of the body with the head secure between the thumb and forefinger. Often, some species (*Brachylophus* and sometimes *Dipsosaurus*) can be held on the palm of the hand, eliminating body or head restraint altogether. Larger juvenile, subadult, and adult iguanas should be restrained with two hands. One hand should lightly, yet firmly grasp the animal behind the head, either in the neck or shoulder region to prevent the animal from turning and biting. The second hand should be placed over the pelvic region, keeping a firm grasp on the rear legs that are often brought forward to scratch the hand or arm that is restraining the head. The tail of the iguana is also a powerful weapon and can be restrained under the arm of the rear hand. In many cases, restraining the tail and one of the rear legs in a single grip is easier and more efficient.

When possible, large iguanas should be restrained by two people with one person holding the head and a second indi-



Tandora Grant illustrates that large iguanas (in this case a Lesser Antillean Iguana, *Iguana delicatissima*) are best handled by grasping the head or neck with one hand and the tail and one rear leg with the other hand.



“Tame” iguanas can be supported on one arm, while the tail and rear end of the animal are gently grasped or supported with the other hand. If the animal becomes agitated or tries to flee, the supporting front hand can easily restrain the head or the animal can be set down. Here Allison Alberts handles “Gitmo,” a large Cuban Iguana (*Cyclura nubila nubila*).



Large iguanas are best restrained by two people, with one person holding the head and a second person holding the tail and rear legs. This is an adult Anegada Iguana (*Cyclura pinguis*).



Iguanas such as this Lesser Antillean Iguana (*Iguana delicatissima*) are easily captured without harm by using large, cloth nets.



Tandora Grant is holding "Gitmo," a large Cuban Iguana (*Cyclura nubila nubila*) that resides at the San Diego Zoo.

vidual holding the hindquarters of the animal. During measurements of larger iguanas, some keepers and field researchers have found that blindfolds such as elastic knee bands placed over the entire head of the animal work well to calm the animal and keep it from attempting to bite. This technique also will help protect the person taking measurements, as many species of iguana will keep the mouth agape during restraint, and any hand movement near the mouth may result in a bite.

In some cases, large, tame iguanas can be handled without restraint for purposes of education. The easiest way to handle these individuals is by resting them on the forearm with the hand gently supporting the chest of the animal. The handler's second hand is used to support the rear of the body. If the animal should become agitated, the forward hand can easily be shifted to restrain the head of the animal while the handler's other hand can restrain the tail and/or rear legs. So-called "tame" animals can quickly become nervous or irritated outside of their normal quarters, and handlers should always be aware of their surroundings, in case an animal needs to be restrained.

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PROFILE

Rick van Veen: A Feral Mammal's Worst Nightmare

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Rick van Veen was born the son of a Dutch father and an Australian mother in upstate New York on 27 June 1967. Rick's stint in the U.S. was short-lived, as the family moved to Australia when he was five months old. There, in the herp-rich outback, an extraordinary herper was born. At age four, Rick brought home his first snake, a venomous Copperhead (*Austrelaps superbus*) that he had usurped from a Kookaburra. That snake didn't bite Rick, but others did — included was a Sea Snake (*Enhydrina schistosa*), a Spotted Black Snake (*Pseudechis guttata*), a Tiger Snake (*Notechis scutatus*), a Brown

Snake (*Pseudonaja textilis*), and half a dozen "lesser" elapids. The Brown Snake incident resulted in Rick being in a coma for 48 hours — an ordeal that left him with some lingering liver and kidney problems, as well as some apparent neurological anomalies (see below). Fittingly, Rick would later serve as an instructor on snake handling techniques for the Queensland Department of Environment; perhaps more appropriately, he also served as an instructor on snakebite first aid.

Rick's educational and work history reflect a man who has followed his dreams, and they have been varied. Says Rick: "If it ain't fun, I ain't doing it." Of course, Rick's idea of fun is somewhat different from what most people would regard as even bearable. Remarks one of Rick's former Australian employers: "Rick's exploits in the field are legendary... He actually seems to enjoy the sorts of conditions that most people would find downright unbearable." One could not get a better recommendation for prospective work in the harsh Hellshire Hills of Jamaica. Indeed, Rick quickly attained legendary status in Jamaica. Also, those of us who work with him soon came to realize that, when Rick suggests some seemingly insane and undoable course of action, he is usually serious — and, then, invariably produces. For example, Rick has been parlaying his masonry skills into converting our humble stick research station into a veritable rock fortress, an exercise that requires him to carry 90-lb bags of cement into the interior forest, not to mention other bulky or heavy construction materials.

After early stints as a brick layer and horticulturist, Rick focused full-time on pursuing a career in field biology and conservation — a career that has extended, literally, from the equator to the Antarctic. During this time, Rick also completed a BSc degree in Botany/Zoology at James Cook University in Queensland. Rick's employment history has included seven years working for the Queensland National Parks research branch on crocodiles, sea turtles, and endangered macropods (kangaroos, etc.); more to the south, he worked on pack-ice seal surveys with the Tasmania/Australia Antarctic Division, and studied the feeding ecology of Macaroni Penguins on Heard Island. Rick gained additional animal handling skills working for a variety of Australian wildlife parks, including the Curumbin Wildlife Sanctuary, the Healesville Wildlife Sanctuary, and the Ballarat Wildlife & Reptile Park.

More recently, Rick worked as resident naturalist at the Pajinka Wilderness Lodge on the Cape York Peninsula, and, from 2002–2003, served as coordinator for the Pomputraaw



Rick van Veen on Heard Island, contemplating work closer to the equator. Photograph by Tony Dorr.



Up close and personal with an Elephant Seal: Rick pondering the wisdom of working on subjects that outweigh him by an order of magnitude. *Photograph by Tony Dorr.*

Aboriginal Land & Sea Management Centre. These latter positions involved significant feral animal control work — experiences that uniquely prepared Rick for front line duties in the Hellshire Hills. For example, Rick participated in the “control” (i.e., with extreme prejudice) of thousands of wild pigs — providing the training that has made him the uncontested wild boar king on the Jamaican Iguana project. The rest of us remain humble pretenders.

Oddly, Rick has long had a love for iguanas; odd because he grew up in a country devoid of iguanas despite harboring one of the world’s richest and most dramatic lizard faunas. Whatever the explanation for his fascination with iguanas, in 2000, Rick was able to whet his appetite by assisting with vegetation surveys and dietary analyses of the Fijian Crested Iguana at the Yandua-tabu Island Iguana Conservation Reserve. Determined to become fully immersed in iguana work, Rick traveled to the U.S. in 2003, passing by the Fort Worth Zoo en route to attending the annual IUCN Iguana Specialist Group meeting in the Turks and Caicos Islands. Fortunately, Rick Hudson, a conservation biologist at Fort Worth, saw Hellshire written all over van Veen and cleverly pointed him south, toward the Jamaican Iguana project.

Funds to hire Rick came initially from grants from the Miami Metrozoo and the Audubon Zoo. These were designated for a 3-month pitfall trap survey and associated mammal control experiment in the core iguana area. This project involved spending periods of over a month in the remote interior of the Hellshire Hills, and a trap-checking regimen that entailed walking the equivalent distance of the entire peninsula every day for the 48-day census period. Rick began capturing and observing iguanas during this time, and quickly established that he was just the sort of biologist who could work happily and productively in Hellshire’s interior forest. A grant from Conservation International and the efforts of the International Iguana Foundation have secured funding to retain Rick’s talents through 2004, and a major effort is now being directed at obtaining funds to keep him in Jamaica for the remainder of his natural life (see www.IguanaFoundation.org).

Next on the agenda for Rick is a radio-telemetry study that will involve attaching transmitters to 20 hatchling iguanas during the September (2004) hatching period. This endeavor will

yield critical ecological data on the most vulnerable, but poorly known life history stage of the species. Indeed, aside from obviously high mortality rates resulting from predation by exotic mammals, virtually nothing is known about the habitat preferences, activity patterns, and movement ecology of young iguanas. Rick’s skill and demonstrated dedication will no doubt ensure that this project will come to fruition. Radio-tracking wild adults, especially post-partum females, is planned for the 2005 nesting season. That effort will help delineate the extent and characteristics of the habitat used by wild iguanas during the non-nesting portions of the year.

Aside from the continued monitoring of both wild and headstarted iguanas in the core conservation zone, Rick’s participation will also enable us to embark on other high priority projects that have long awaited implementation. For example, survey work in the early 1990s identified a population of iguanas in the western Hellshire Hills that we have not been able to revisit. We plan to assess the status of this forgotten population, and will focus on the location and subsequent monitoring of nesting sites. That activity will permit harvesting a new source of wild hatchlings to provide fresh genetic material for the captive population. At present, all captives are derived from a handful of females that nest at two known communal nesting areas in central Hellshire. Additional nesting areas obviously exist. An infusion of new genetic variation will be a boon to the existing zoo population that now serves as a hedge against extinction —



Rick processing a Jamaican Iguana in the Hellshire Hills.

and as a source of headstarters for use in on-going and future repatriation exercises.

Unfortunately, the future outlook for the iguana in the Hellshire Hills does not look bright. The plethora of invasive species (e.g., dogs, cats, rats, mongooses, pigs) will never be eradicated — only controlled through labor-intensive trapping efforts that will be difficult to maintain in both the short and long term. In addition, illegal logging activities continue to erode the remaining natural forest and pose a security risk to iguana project personnel. Thus, while the preservation of the Hellshire Hills ecosystem is an objective that must be pursued, the only realistic strategy for ensuring the iguana's survival in the wild is the creation of an off-shore population on the Goat Islands. Lying just off the western edge of the Hellshire Peninsula, Great Goat Island in particular has long been recognized as an ideal site for the re-establishment of an iguana population. The island could easily be rendered pest free and iguana friendly, and the prospects for effective, long-term management would be enhanced by economic and logistic feasibility.

Encouragingly, the bureaucratic issues that have historically prevented the initiation of a Goat Island restoration and iguana re-introduction program appear to be approaching resolution. Both the Hellshire Hills and the Goat Islands have



A reflective Rick van Veen, holding a freshly caught Jamaican Iguana in the Hellshire Hills.



Rick van Veen at the research station "South Camp," in the central Hellshire Hills. *Photograph by Dawn Fleuchaus.*



Rick surveying a job well done: a dead mongoose that was trapped and removed from the core Jamaican iguana conservation zone.

been accorded protected area status since 1999, as part of the Portland Bight Protected Area. The government of Jamaica is now taking steps to ensure that appropriate management instruments will be instituted to conserve these national treasures. If all goes well, such a rehabilitation program will become a reality in the near future — and Rick van Veen is the obvious candidate to lead such a crucial field campaign. Rick is not only the right person to launch an assault on the Goat Islands, but has already indicated his enthusiasm for remaining in Jamaica and dedicating himself to the effort.

In summary, Rick's participation in the Jamaican Iguana project has been of incalculable value. Aside from running the field program in Hellshire, he has infused new life into both the local project and the international donor community. In short, Rick has provided the impetus for a renewed thrust to study and conserve the Jamaican Iguana and its unique but critically imperiled ecosystem. He also has made the project a more entertaining enterprise for the rest of us participants. Although clearly comfortable with a hermit's solitude, Rick is a gregarious sort whose consistent good humor and contagious enthusiasm have been an invigorating influence at all levels of the project. In particular, for those of us who love wild pig meat, Rick has improved the quality of our lives in such a dramatic fashion, we often find ourselves embarrassingly grateful.

HISTORICAL PERSPECTIVES

The Iguana

Iguana iguana iguana (L)¹

Paul L. Swanson

The following observations on the iguana were made during a two year stay in Panama: in the tropical forest vicinity of Pacora, in the sabanas around La Chorrera and in the various habitats found within the Canal Zone.

Terminology

The name iguana is the only one that I have heard used for this lizard by English speaking people, with the exception of show people in the United States who sometimes use more spectacular terms, such as “dragon.” In Central America the Spanish-speaking people usually call the female *iguana* and the male *gorrobo*. The male is sometimes called *ministro* in El Salvador, and *guacho* in Costa Rica. The young, of course, is called *iguanita* or *gorroboto*. In Panama the lizard is facetiously called *gallina de palo*, “chicken of the tree.” Most Americans consider any small lizards in the tropics iguanas, ameivas and basilisks in particular, just as they call almost any tree a mahogany tree.

Sexual Dimorphism

Males of this species show quite a variety of color; their heads vary from whitish, grayish, pinkish, to orange and black. The males in general have more orange and yellow coloring than the females, which are lighter colored and more greenish. Females are usually smaller than males of the same age, and the head is smaller in proportion to the body. The dorsal spines are shorter in the female, being from one-half to one inch in length, while those of the male are two inches or more. The male has a row of glands on the underside of each thigh. Externally they appear as disc-shaped, warty excrescences; just beneath the skin they are spherical in shape and measure from four to six millimeters in diameter. One male had 17 on one leg, 18 on the other.

There is a belief in El Salvador that these glands are warts. It is believed that a person can get warts from the blood of an iguana, unless it is washed off before it becomes dry. I have asked Salvadoreans why warts were common in the United States, where there are no iguanas. I was told that they could be acquired from inadvertently coming in contact with urine from a person having warts. When I asked how they explained the fact that children had warts more commonly than adults, I was told that they were transmitted through the mother. When told about the myth prevalent in the United States, that handling toads caused warts, they were not familiar with this belief, and denied vehemently that toads would cause warts.

Male iguanas either outnumber the females, in adults, or are more conspicuous in their habits. On one trip I collected seven males to one female. Possibly among the older population, more males survive predators than the smaller females.

Habitat

The iguana is quite arboreal in its habits, but it is also at home on the ground. It is an excellent swimmer and takes voluntarily to the water to escape its enemies. I have never observed adults very far away from trees, although the young will wander quite a distance from them. They are particularly numerous in trees overhanging rivers, or perhaps they are more easily observed from the water. During cold, wet weather, they seem to prefer to stay on the ground, probably for greater warmth afforded by ground cover, such as brush, hollow logs, holes, etc. On one collecting trip, after a prolonged cool and wet period, I observed no iguanas in the trees. Then the sun came out, and as it rapidly warmed up, iguanas were noticed coming to the tops of bushes and ascending into the tops of trees. In favorable weather, they apparently spend most of the time in the trees and even sleep there overnight.

I once watched an old male, in a big fig tree near Gatun, for several days. The tree was more or less isolated from others, and as the iguana had an unusual reddish color to its head, I felt reasonably sure that it was the same specimen. I could see him from quite a distance, but when I came beneath the tree, he tried to keep a branch between us. I first noticed him on September 20. On the 21st I was working in the same locality and observed him every time I looked for him, from 7:30 a.m. until 2:15 p.m., when I left. On the 22nd I couldn't locate him. On the 23rd I saw him at 8 a.m. That day, while I was away eating my lunch, some of the men in my crew of laborers entertained themselves by catching this iguana for me. They had not known that I was watching it, and thought I'd be pleased with it.

Another large male was conspicuous in a big ceiba tree at Fort Davis. It was late in November, and the tree was bare of leaves. The new leaves were coming out and the iguana was feeding on the new shoots. This lizard remained in the same tree for at least four days.

Their choice of trees is based mostly on the food available at the time, as they probably select the species according to the season of new shoots, flowers, fruit or leaves. Apart from the feeding angle, they seem to prefer heavily foliated trees when the sun is bright, and when it is raining, more open trees are preferred, such as the wild fig. Species to which they seem particularly partial are the wild plums, *Spondias* species; the palo bobo, *Erythrina glauca*; the guacimo, *Luehea seemannii*; the wild cashew, *Espave*

¹ Originally published in *Herpetologica* 6:187–193 (1950). Reprinted with permission. Bracketed names were added and one typographical error corrected.



A Central American Green Iguana (*Iguana iguana*). Photograph by Robert W. Henderson.

excelsum, to mention a few. They are liable to be found on almost any tree, however, even small species like the *Cecropias*.

I once saw two iguanas we had shaken from a tree run into an armadillo hole to escape capture. When frightened from a tree growing on the bank of a river, they prefer to jump into the water rather than on land. They usually swim under water and come up under brush along the shore line, if such is available. A jump from a tall tree doesn't seem to hurt them. I've seen them leap from heights of forty or fifty feet and apparently land unharmed. Some times their tail is broken by intervening branches, or brush, but even if they hit practically bare ground, it takes a "flying tackle" at the moment of contact to capture one before it runs away.

Very young iguanas are frequently seen on the ground, sometimes in open areas, and they are probably terrestrial to a large degree. I have never seen one under ten or twelve inches in a tree, although smaller lizards would naturally be more difficult to observe there than on the ground. (I have observed many small lizards of other species in trees, however).

Locomotion

Iguanas are very agile climbers. I once observed a specimen climb the underside of a fairly large and smooth limb. They attempt to keep a limb between them and an observer, in the manner of a squirrel. Sometimes they will go from one tree to another, if the branches are interlaced, and I have seen them make short jumps from one tree to another. In leaping to the ground or to the water

from a tall tree, they hold the legs closely to the body in flight. I have not been able to verify how they break their fall, but it would seem that they would have to extend the legs, and that they might use the tail to some extent. While the tail isn't so brittle as that of most lizards, one frequently captures specimens with part of the tail regenerated.

At rest in a tree, they sometimes sprawl out parallel to a limb with the hind legs dangling over into space, not even the claws being in contact with the limb.

In swimming, an iguana lets its four legs hang limply against its side, and propels itself with powerful strokes of the tail, much like a crocodilian. I have never seen one swim on the surface; they were always submerged.

Once I released an iguana on an open grassy area. At first it wouldn't try to run away, so I left it for about an hour, and when I returned it had started to walk. When it saw me, it began to run, but I overtook it easily, when it again became quiescent. Although this specimen traveled not more than seven miles per hour, I believe that an undisturbed adult could probably attain a speed of ten or twelve miles per hour for a short distance.

Food Habits

One of the favorite foods of the iguana in Panama is the wild plum, *Spondias mombin*. The fruit is about 1 1/4 to 1 1/2 inches in length, by about 3/4 inch in diameter, shaped somewhat like a prune, and containing a large pit. It ripens over a long period in August and September. Of seven iguanas I dissected on

September 2 (1943), five of them contained plums: 16, 29, 39, 41 and 79, respectively. The one with 16 plums also had many leaves in its stomach, the others very few. One other contained leaves and seeds of the guacimo tree. The only female of the seven contained no plums and only a few leaves, but a great many seeds, which my woodsmen identified as fig seeds, although one of them disagreed and insisted that they were seeds of the canillo, *Miconia argentea*.

Other iguanas dissected contained fruit of the pepenance, *Ximenia americana*, and mango leaves. I have observed them eating the leaves of the morning glory, *Ipomoea* species, and new shoots of the ceiba, *Ceiba pentandra*. They undoubtedly eat many different species of leaves, blossoms, buds and fruit. Native Panamanians and Salvadoreans claim that they frequently eat leaves from vegetables in gardens. Several natives claimed that they had seen iguanas, not once, but a number of times, eat human excrement. In captivity I have had them eat ripe bananas.

Very young iguanas are probably almost entirely insectivorous², but I have made no personal observations on their feeding habits. I find no mention of stomach stones in my notes, nor do I remember finding any.

Mating

I have not observed iguanas in the act of mating. One of my workers saw a pair mating in El Salvador. If he remembered correctly it was in October. They were closely intertwined and upon the ground. Another claimed that they mated in November at the close of the winter (rainy season). It is very likely that mating takes place upon the ground; if it took place in trees it would be more often observed. Many of my men were excellent woodsmen and observers of nature, but few had ever seen iguanas mating.

Egg Laying

The eggs are laid from early February to March. They are spherical in shape and have a white shell, about 30 mm. in diameter. One informant told me that they are laid on the ground and covered with dirt. They probably hatch in about three months. (Young iguanas are commonly seen from June on). The number deposited varies greatly; there may be as few as twenty or as many as seventy. A specimen dissected on a September 26 contained 72 eggs, varying from 3 to 6 mm in diameter; the total number probably represented more than one clutch. Another examined on a November 21 contained 28 large eggs, of about 15 mm. in diameter, and many that were much smaller. Late in January the eggs are about 25 mm. in diameter.

Growth

Young iguanas are observed most often in June and July. A native observer said that they reached a length of about three feet at the end of their first year. This sounds reasonable, as in June or July most specimens seem to be under ten inches or over three feet in length. They probably attain full size in two years. Older specimens seem to become thicker in build but do not grow much in

length. A specimen five feet in total length, and weighing about ten pounds, may be considered large. The largest specimen of many hundreds that came to my attention was caught at Fort Gulick, Canal Zone. It weighed 13 1/4 pounds, and measured 66 1/2 inches in total length, 4 inches of the tail having been regenerated. With a normal tail it would not have been more than an inch or two longer. The snout to vent length was 20 1/4 inches. I have not seen wild ones (at large) that I thought were any larger than this specimen.

Frequency

Iguanas are very common in many places where they occur. In a hunt for them near Margarita, Canal Zone, on a September 26, I personally observed 39 specimens in two hours; of these my five helpers caught 8. They undoubtedly saw many more that I did not. That afternoon I observed 20 more, although I was not hunting for them then.

Between Margarita and Gatun, while driving slowly along the road one morning shortly after sunrise, I counted 58 iguanas sunning themselves on the tops of trees, within a distance of three miles. It is not unusual to see four or five in a tree. We once routed 12 iguanas from one fig tree, *Ficus glabrata*.

Enemies

Many iguanas are marked by bad scars. According to the natives, most of the scars are the result of attacks by hawks. I have no reason to doubt this, as hawks are very numerous in the tropics, and the iguana's habit of basking in the tops of tall trees would make it very logical prey. The fear of hawks is the basis of a stratagem for catching iguanas. The native whistles or screams like a hawk, which "freezes" the lizard and makes it easier to capture. I can not vouch for this personally, but I do not discredit it, as when frightened badly enough, an iguana usually remains motionless.

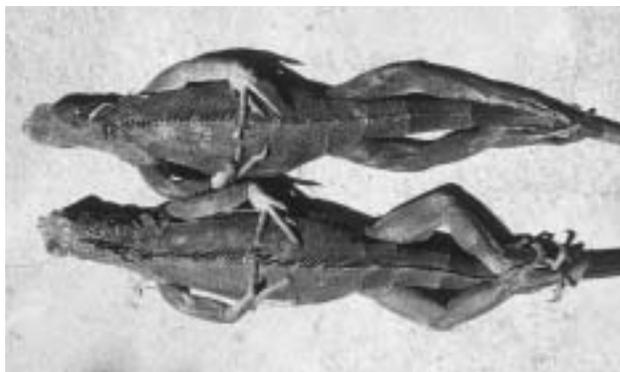
Boas and other snakes undoubtedly eat many iguanas. Small snakes are capable of eating young specimens. We once caught a boa, *Constrictor c. imperator* [= *Boa constrictor*] of only six feet in length that contained an adult iguana. It was a big meal for the snake, and the tremendous bulge it made in his body rendered the capture of the snake very easy. I have no records of predatory mammals attacking iguanas, although I see no reason why they should not.

Defense

The iguana's chief defense against its enemies is probably its ability to climb, run, and swim. Its protective coloration is an aid in escaping the notice of many potential enemies. It is amazing how inconspicuous it can be. I have talked to people who have lived in the Canal Zone for two or three years without having noticed a wild iguana, although they are present in large numbers in many parts of the Zone. Once when on a hunt, five good *campesinos* and myself could observe but three iguanas in a guacimo tree. A couple of the boys climbed it, and frightened *ten* iguanas to the ground.

Their keen vision helps them to avoid enemies. On an open sabana, one gave evidence of having seen me while I was still 100 yards away. I have tried to approach them in trees close enough to photograph, but could seldom get within 25 feet of one before it would leap to the ground.

² Editors' note: Green Iguanas of any age are herbivorous. Accounts of insectivory are due to incidents induced in captivity and should not be used to justify feeding meat or insects to captive Green Iguanas.



Green Iguanas still appear regularly at Central American markets. *Photographs by Gunther Köhler.*

Usually a captured specimen offers no resistance. If it is released and teased, it sometimes puts up quite a show of angry defense. Some of my men once caught and released an iguana, unknown to me. I came upon it, thinking it a wild one, and when I got close enough, it lashed out with its tail, striking me on the side of my thigh between the knee and hip. It raised a welt which lasted several hours. It also threatened to bite. I took it into a cabin and thrust a broom at it. The lizard struck at the broom with his tail, then bit at it savagely, taking off part of the straw. Another specimen, trussed up in the usual Panamanian manner, managed to get its front legs loose and bruised one of my companions arms with its tail. Wounded specimens are much more likely to fight than uninjured ones. Some natives claim they can make a good account of themselves with a small dog.

Commercial Value³

Iguanas are a source of meat for a great many tropical American people. Their use as food seems to be confined to the areas where they are indigenous, as they are seldom transported from the lowland tropics to the cities at higher elevations where the iguana does not occur. Most natives of Central America who live where iguanas occur consider them excellent food. The Jamaican negroes who worked for me in the Canal Zone could hardly conceal their disgust at people eating lizards. Some of the highlanders of Central America feel the same way. Personally, I think they are delicious.

Unlike most animals, old specimens are better eating than young ones, perhaps because they are not so agile, resulting in softer muscles than in young, active specimens. Their diet probably affects the taste also, as younger individuals may not have completely overcome the insectivorous habits of their infancy. Possibly when feeding on fruits they have a better flavor than when feeding on leaves and other vegetation that would impart a flavor less palatable to humans. In the dry season they are not as good eating as in the rainy season. One I cooked for three hours in July remained tough and not very tasty. Just after egg laying, in March, to about July, they are at their worst. They are usually considered at their best in September and October. Many

writers have mentioned tasting the flesh of the iguana and finding it unpalatable. In such cases, they have either let their imagination get the best of them, have tasted them at the wrong season or have tried too young a specimen. I have eaten many of them and find them delicious — equal if not superior to chicken.

Their eggs are also considered a delicacy. I have eaten them taken from an iguana and boiled. To me they tasted much the same as the hard boiled yolk of a hen's egg, and had much the same appearance. The natives also eat them dried, as sort of a confection.

The market value of iguanas varies much from country to country. In Panama, in 1943, at the market in Panama City, a large female with eggs sold for about \$2.00 (males slightly cheaper). At the same time, the best class of fish retailed for about 32 cents per pound; chickens 60 cents live weight and 70 cents dressed. Such an iguana would weigh 8 to 10 pounds. Turtle steaks were 30 cents per pound.

In El Salvador at the same time, a similar iguana sold for the equivalent of 30 cents to 40 cents U.S. In Nicaragua they could be bought for as little as 15 cents U.S.

Eggs of the iguana sold in Panama City at 7 for 10c and in Cartagena for as little as 4 for 1c U.S. In Barranquilla, a string of 50 was sold for about 25c U.S.

The iguana is a particularly convenient source of meat in hot places, as it can be kept alive for a long period without food or water. In Panama it is the custom to fold the legs over the back, securing them by slitting the skin of the toes and placing a claw of one foot through the tendons of the toes of the opposite foot, and twisting them. This renders the iguana helpless. In Panama City one may see dozens of them lying in the street of the market place. I am told that in Venezuela the natives simply break the iguana's back to keep it more or less immobile.

I do not recall having heard an iguana voice a sound of any kind. However some of the mestizos who worked for me told me of an occasion in which an iguana caused much excitement among the sight seers who flocked off a boat at Cristobal. The big lizard, held by a Panamanian, made lots of peculiar noises, whistled and "talked." An excited gringo thought that he had made a wonderful discovery for some zoo, and convinced the Panamanian to part with it for the measly sum of \$10.00. Of course it was a trick of ventriloquy.

³ See also "A backward glance at iguana exploitation" (IGUANA 10(3):63-66).

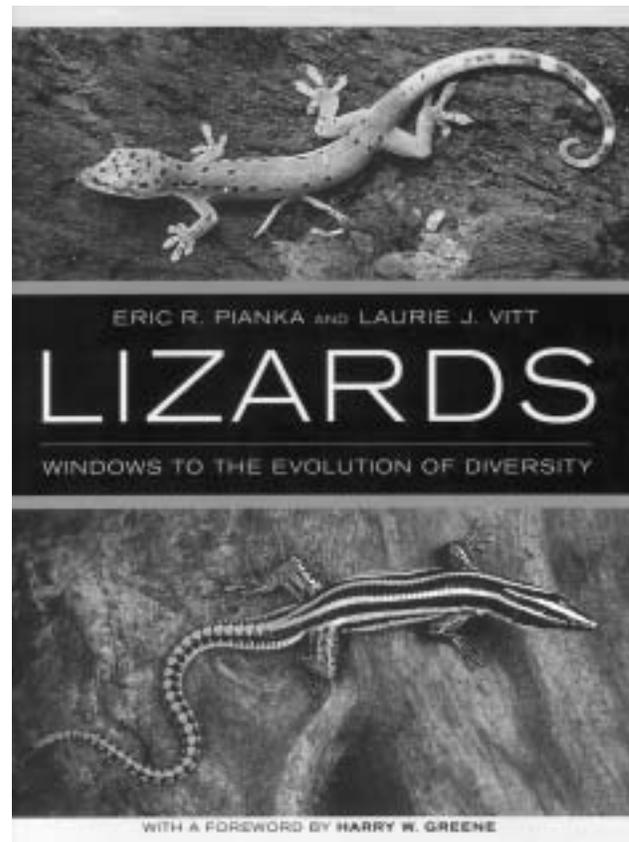
BOOK REVIEWS

Lizards: Windows to the Evolution of Diversity. Eric R. Pianka and Laurie J. Vitt. 2003. University of California Press, Berkeley and Los Angeles, California. 333 pp. 218 photographs, 8 tables, 31 figures, glossary, index. Clothbound, \$45.

In *Lizards: Windows to the Evolution of Diversity*, Erik Pianka and Laurie Vitt have provided the lay public (and the highly educated “experts”) with an invaluable and exhaustive summary of what is known about lizard ecology. Although they may have been a bit ambitious in trying to include such a wealth of information in a book designed for the coffee table, they have certainly achieved their stated goal of providing “an up-to-date, more scientific reference for lay people.”

This well-organized and scrupulously researched volume examines lizard ecology from several angles. The first of three parts is entitled ‘Lizard Lifestyles.’ It examines the various ecological niches filled by lizards. After a brief introduction to lizard phylogeny and classification, the authors highlight many of the adaptations that lizards have evolved to accommodate their diverse lifestyles. This section includes a discussion of the astounding array of locomotor mechanisms, from prehensile tails to zygodactylism (look it up!) to sticky toe pads. The discussion also considers physiological adaptations to different environments, such as water retention strategies and sometimes surprisingly effective thermoregulatory behaviors and mechanisms. Desert lizards, for example, maintain a fairly constant body temperature despite large thermal fluctuations throughout the day. Other lizards, such as nocturnal geckos, largely conform to the ambient temperatures of their environment. This is followed by an examination of predation tactics, which range from highly active foraging to what is termed a ‘sit-and-wait’ strategy. Some lizards, such as Monitors (a group that includes the Komodo Dragon), actively track large vertebrate and invertebrate prey. Others, such as chameleons, wait passively and ambush invertebrate prey with their projectile tongues. The authors next review escape behavior, which can range from highly alert and active flight (sometimes literally) to a heavy but essentially passive reliance on crypsis. For instance, most species of Horned Lizards either remain motionless when threatened or run for a short distance and then freeze, relying on camouflage to blend imperceptibly into the habitat; in contrast, Racerunners rely almost solely on speed to evade capture. Finally, they address social and reproductive strategies that run the spectrum from large male territories that overlap with those of several females to long-term monogamous pairings. The section is summarized with a review of how these various features and strategies apply to the challenges lizards face in the various natural settings and ecological roles for which they are adapted.

The second part is a trek through what is currently known about lizard phylogeny. Building on information presented in the previous section, the authors proceed to examine a sample of the adaptive radiations that correspond to the various lizard phylogenies. Special attention is paid to examples of convergent evolution (a Pianka specialty), where similar strategies have been adopted by disparate groups of lizards in response to essentially similar environmental pressures. The Thorny Devil (*Moloch horridus*) of



Australian deserts and the Horned Lizards (*Phrynosoma* spp.) of the American Southwest are both dorsoventrally flattened, stout-bodied lizards covered with a number of unfriendly looking spines and protrusions. Not only are they essentially similar in appearance, they behave and function ecologically in much the same fashion; both rely heavily on crypsis to evade predation and both are sit-and-wait foragers that feed almost exclusively on ants.

All of this information is united and placed into a coherent context in the last part. A chapter on historical perspectives attempts to trace the adaptations and radiations of lizards through time, explaining their prevalence or absence on certain continents or under certain environmental conditions. The last chapter examines the somewhat uneven relationship of humans with lizards, highlighting the rich history of lizards in culture and mythology — and examining the pressures (almost invariably of human origin) that threaten the continued co-existence of these rather disparate life forms.

Although the section on lizard diversity contains a wealth of information, what the authors chose to present varies considerably from one group to another. For some taxa, they discuss in great detail dozens of species and their many specific behaviors and adaptations. For others, such as chameleons, they cite only two or three species and very few specific examples of unique adaptations or behaviors, instead devoting most of the section to a discussion of very general physiological traits. This can be somewhat frustrating if one bought the book with the intention of enhancing one’s knowledge of a particular genus or family, only



One of the more interesting chapters is that on "Lizards and Humans," in which this petroglyph of a Chuckwalla (*Sauromalus ater*) from Arizona is illustrated. Photograph by Jim Rorabaugh.

to find that that particular group was given only cursory attention. Because of that uneven coverage, I would hesitate to portray the book as comprehensive. Although it provides substantial detail on a broad range of lizard groups, that obvious depth merely reflects a pronounced bias toward species and genera with which the authors have worked (Pianka largely on desert lizards in North America, southern Africa, and Australia; Vitt on taxa found in the southwestern United States and the mainland Neotropics). This would explain the relative dearth of information on iguanas, most of which live outside the areas frequented by the authors — but which are certainly deserving of more attention, if only because some of them are among the most endangered reptiles in the world. West Indian anoles comprise another group that deserves more attention than given; these lizards have been instrumental subjects in many studies that have provided new insights into the evolution of ecological relationships. Despite the fact that both authors have been phenomenally prolific and have contributed greatly to a better understanding of ecology and herpetology (those of us who are interested specifically in the ecological relationships of reptiles have long been exposed to the profusion of their professional publications), such expertise would unavoidably have led to a better acquaintance with some lizards than others.

Had the book been presented as a textbook, this partiality would be a genuine cause for concern. However, the attentive reader should have been forewarned of this bias, as Harry W. Greene stated in the foreword: "In some ways this is a book about two curious boys who grew up chasing lizards ... and have now synthesized their collective life's work to date." Possibly the most entertaining elements of the book occur when one or the other of the authors reverts to boyhood by recounting a particularly memorable event or expressing a youthful passion for a specific subject. Such asides are scattered throughout the volume and, whenever I turned a page and encountered one, I stopped wherever I was and immediately turned my attention to the story at hand — and inevitably found myself wishing for more.

Throughout the book, Pianka and Vitt frequently pose questions that are meant to inspire more research into some aspect of lizard ecology, phylogeny, or physiology. They also are not averse to making new and interesting generalizations about lizard ecology, including numerous observations about phylogenetic trends in foraging modes and diet composition. Unfortunately, these are not always clearly identified, and the lay reader may experience some difficulty distinguishing new and novel observations from those that have been with us for some time and are widely accepted as true.

Overall, the book is simultaneously thorough and eminently understandable. The depth of coverage results in a volume that is a bit too thick for cover-to-cover reading, although the generally easy-to-read style, presumably a composite effort by the two authors (or very effective editorial work), tempts the reader to stay with the book longer than such a specialized subject might normally merit. Actually, the combination of authority and entertainment creates a rather odd combination of text and coffee table book. In fact, the relative brevity of coverage of some lizard groups may be all that keeps this volume from serving as an adequately comprehensive textbook on lizards. That impression is enhanced further by the abundance of charts and tables, far more than one would expect of a book designed for casual perusal and mere entertainment. Also, the volume contains relatively fewer glossy photos and illustrations than the typical coffee table book — and all that are included seem to illustrate what the authors would lead us to believe are important aspects of lizard biology. Conversely, those wonderful anecdotes are just plain fun!

Ultimately, this book is a terrific resource. The depth of information presented will provide lasting value long after one has thumbed through the glossy photos and read all the captions. Certainly comparable to Rick Shine's *Australian Snakes: A Natural History* and Harry Greene's *Snakes: The Evolution of Mystery in Nature*, until now the best examples of large, profusely illustrated books capable of both educating and inspiring the reader, lizard lovers no longer have to envy the snake fanciers. A bargain at the price, everyone with even a casual interest in lizards should have a copy prominently displayed on their very own coffee table.

Aaron Z. Savit
Ann Arbor, Michigan

IGUANA NEWSBRIEFS

Iguana Specialist Group Awarded Grant for Anegada Iguana Conservation

The ISG received one of two \$15,000 grants from the Sir Peter Scott Fund for Conservation Action. This is the first year these grants have been offered and the ISG was extremely fortunate in having the Anegada Iguana project selected.

The project is titled: "Species Recovery Plan Implementation and Local Conservation Awareness for the Critically Endangered Anegada Iguana."

The award letter from David Brackett, Chair, IUCN Species Survival Commission, noted that his office and the IUCN Species Programme "were impressed with the proposed activities outlined in [this] project proposal. We believe the project will make a marked difference to conservation efforts for this species. We also hope that, as one of the first projects to be awarded funding under this new initiative, [it] will generate interest and support for our ongoing efforts to replenish the Fund."

Grand Cayman Headstart Facility Upgrade 30 July – 13 August 2004

As the first of this year's record number of Blue Iguanas began to hatch, "Team Blue," a group of international volunteers, arrived on Grand Cayman to ensure that animals would have new housing prepared for them at the Captive Breeding Facility in Queen Elizabeth II Botanic Park (see also the article on p. 148). Assembled by John Binns of the International Reptile Conservation Foundation, the team included participants from the UK and the US, some of the latter representing US zoos as well as the IIS.

Several members of the team brought along equipment and donations, as did a number of enthusiastic Caymanian volunteers. From an initial prototype of four attached 4 x 4 ft cages, the group organized an assembly line, sawing lumber, notching and screwing pre-cut pieces together, and covering each completed unit with screen mesh. Others

were charged with the seemingly endless task of cutting cage doors and attaching hinges and bolts to the 102 units that were produced within a new compound. Even as the saws and power drills hummed, contractors were busy mixing and pouring cement for the construction of larger enclosures for a number of breeding pairs.

Meanwhile, in the current iguana housing area, other team members cleaned, repaired, and refurbished existing cages, making creative use of natural elements from the surrounding Botanic Park to enrich the cage environments. Within the larger breeding pens that had already been constructed, shovels and wheelbarrows were used to move rock, soil, and vegetation to improve the physical layout.

Even as new cages were completed, some were quickly furnished and their new tenants moved in, mostly two year-olds due for release in September into the neighboring Salina Reserve. Some members of the team undertook a quick survey of this rather rocky and forbidding



Anegada iguana (*Cyclura pinguis*). Photograph by John Binns.



Aerial photo taken after completion of Team Blue's efforts. Photograph by John Binns.

territory, followed later by a helicopter fly-over, during which several soil deposits were identified as possible nesting areas.

IIS Members Survive Daytona Hurricane

Even Hurricane Charley didn't dampen the spirits of dedicated reptile lovers at this year's Daytona Beach Reptile Expo on 14–15 August. The International Iguana Society was on hand to share conservation information and tips on iguana care. Several new members signed on and a lot of people dropped by to renew existing memberships, chat, and hang out with our spokelizards. Jane Billette from the Mid-Michigan Reptile Rescue brought along Scrub, a Rhinoceros Iguana, Azul, a Blue Iguana hybrid, as well as Emma, Marilyn, and Picasso, three rescued Green Iguanas. Also delighting our visitors was Chuck, IIS President Joe Wasilewski's Cuban Iguana, who many long-time members will remember from cover photos in the *Iguana Times*.

Attendance at the Expo was down somewhat due to the weather this year. Hopefully everyone who couldn't make it this year will make it in 2005, when the auc-

tion will be run by the IIS in order to raise funds for iguana conservation. We're already making plans and collecting donated items to be auctioned. If you'd like more information about the auction or have items you'd like to donate, please contact AJ Gutman at ctenosaura@cyclura.com.

Many thanks to all our wonderful volunteers who made this year's show so much fun! We hope to see you all again next year.

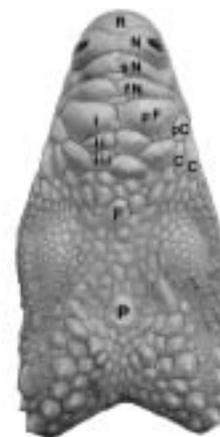
Early hatch for Jamaican iguanas

2004 was a record early hatch, with 59 hatchlings emerging before September. Fortunately, Edwin Duffus had erected barriers surrounding the known communal nesting sites by the third week of August, so all of those hatchlings were collected. Rick van Veen, who is leading the field effort in the Hellshire Hills, brought 19 individuals to the Hope Zoo for "headstarting," attached small radio transmitters to another 18, and released the remainder in the vicinity of their hatch location. Preliminary results from radio tracking indicate that hatchling iguanas disperse away from nesting sites in random directions, and some individ-

uals immediately disperse considerable distances (up to several hundred meters). While not on the move, hatchlings appear to spend nearly all their time in trees and, after one week post-release, several individuals appear to be restricting their activity to small areas — suggesting that they may be establishing territories or home ranges. Unfortunately, the imminent arrival of Hurricane Ivan has interrupted data collection, as safety concerns have dictated that Rick leave Hellshire and return to Kingston. Radio telemetry work and monitoring of the remaining iguana nests will commence once the hurricane passes and he can return to the field.

Cyclura lewisi Elevated to Full Species

Fred Burton (2004), based on mtDNA evidence reported in Malone et al. (2000) plus existing and new observations on scale characters, color, geographic and reproductive isolation, and phyly, formally recognized *Cyclura lewisi* (formerly *C. nubila lewisi*) as a full species (see also article on p. 148). *Cyclura nubila caymanensis* retained its subspecific status.



Dorsal view of head scalation typical of *Cyclura lewisi*. Letters identify scales used in comparisons with *C. nubila* and *C. cyclura*. Illustration by John Binns.

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- Malone, C.L., T. Wheeler, J.F. Taylor, and S.K. Davis. 2000. Phylogeography of the Caribbean Rock Iguana (*Cyclura*): Implications for conservation and insights on the biogeographic history of the West Indies. *Molecular Phylogeny and Evolution* 17:269–279.



Editors' Remarks

Although the editorial board has traditionally used this space to comment collectively, two of us are making an exception on this occasion in order to acknowledge all that **AJ Gutman**, the third member of the board, does for the IIS. In addition to her uncanny aptitude for finding errors large and small in articles submitted to *IGUANA*, AJ often serves as the personification of the IIS. When prospective or current members correspond with the IIS, AJ is the person with whom they communicate. Both the IIS Board and the editorial board often speak of AJ as the "glue that holds us together."

AJ also brings considerable expertise to the myriad tasks we set before her. She is a one-person rescue operation for iguanas and other reptiles (see her profile in the *Iguana Times* 9(4):87–90 and her comments on iguana rescue in *IGUANA* 10(4):121–126). Having acquired her knowledge and skills through trial and error and by accumulating very carefully the selected advice of so-called "experts," AJ often contributes insightful perspectives on issues relevant to husbandry — some of which even experienced fanciers often overlook. As both an ardent iguanophile and perspicacious editor, she brings to the Society and to the journal an attention to detail without which we would be much less able to effectively address the Society's goals or produce a journal of increasingly higher quality. Thank you, AJ.

Bob Powell and John Binns

Editorial Note.—The husbandry feature in the previous issue (*IGUANA* 11(2):114–118) included a parenthetical phrase suggesting that "a pry-bar is standard collecting gear when hunting Chuckwallas." That phrase, added during review, was meant to say that "a pry-bar *once was* standard collecting gear ..." The author of the article, Brian Aucone, noted that he would never advocate the destruction of habitat by breaking apart rocks with a pry bar in order to collect a Chuckwalla from the wild. The editors concur.

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Statement of Purpose

The International Iguana Society, Inc. is a not-for-profit corporation dedicated to preserving the biological diversity of iguanas. We believe that the best way to protect iguanas and other native plants and animals is to preserve natural habitats and to encourage development of sustainable economies compatible with the maintenance of biodiversity. To this end, we will: (1) engage in active conservation, initiating, assisting, and funding conservation efforts in cooperation with U.S. and international governmental and private agencies; (2) promote educational efforts related to the preservation of biodiversity; (3) build connections between individuals and the academic, zoo, and conservation communities, providing conduits for education and for involving the general public in efforts to preserve endangered species; and (4) encourage the dissemination and exchange of information on the ecology, population biology, behavior, captive husbandry, taxonomy, and evolution of iguanas.

Membership Information

Iguana, the Journal of The International Iguana Society, is distributed quarterly to members and member organizations. Annual dues:

Individual U.S. and Canadian Membership	\$25.00
Individual Foreign Membership	\$35.00
U.S. and Canadian Organizational Membership*	\$35.00
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(*receives double copies of *Iguana*)

Additional copies are available at a cost of \$6.00 including postage.

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Membership questions? Call AJ at 860-236-8203, or write to: The International Iguana Society, Inc., 133 Steele Road, West Hartford, CT 06119

Solicitations

Members of the I.I.S. are encouraged to contribute articles, letters to the Editor, news items, and announcements for publication in *IGUANA*. General articles can deal with any aspect of iguana biology, including conservation, behavior, ecology, physiology, systematics, or husbandry. Submission of photographs to accompany articles is encouraged.

Manuscripts may be submitted via e-mail (send to ctenosaura@cyclura.com). For any contribution, please include your name, address, phone number, and e-mail address. Authors of one page or more of print will receive a free copy of the journal in which their contribution appears and will receive a PDF file of their article for distribution.

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LETTER FROM THE PRESIDENT AND SECRETARY

Just when you thought that an ordinary iguanophile had few options for helping with conservation work ...

We've been working for Blue Iguanas for years and can recite all the details of their plight in our sleep — world's most endangered reptile, only 20–30 left in the wild, captive breeding program, etc. — but the opportunity for some hands-on involvement came only this summer.

Although it remains one of the most endangered reptiles on earth, the Blue Iguana of Grand Cayman can be saved from extinction. The success of the captive breeding program headed by Fred Burton was apparent as the incubators started filling up with this year's eggs. With the facility in QEII Botanic Park already stretched to capacity with last year's record 84 hatchlings, clearly some help was needed — and help arrived from many quarters. Enter John Binns of the International Reptile Conservation Foundation and his quickly assembled crew of volunteers from Team Blue! The team brought together the talents and enthusiasm of zoo professionals and iguana enthusiasts from around the world. Financial help came from the International Iguana Society (in part from the Rob Dorson Trust Fund), the International Reptile Conservation Foundation (IRCF), the International Iguana Foundation (whose director, Rick Hudson, encouraged the participation of representative from several zoos, including Indianapolis, Tulsa, Knoxville, and Phoenix), and from several very generous local Caymanian individuals and businesses.

From 30 July to 13 August, Team Blue, with the assistance of a variety of local volunteers, swung hammers, wielded shovels, rakes, and assorted power tools, and managed to construct 102 new cages for Blue Iguanas. All of the existing cages got a thorough cleaning and refurbishing, plus repairs where needed. Some of the two-year-old animals slated for September release were already moved into larger quarters and (with the assistance of the local football team!) massive quantities of rock, soil, and vegetation were moved around within the freshly poured cement of the new breeding enclosures in preparation for their future inhabitants.

Volunteers also had a chance to learn about the natural plant components of the Blue Iguana diet, which have led to much-improved breeding success. Some Team members also participated in a rather grueling hike into the rocky and forbidding Salina Reserve to view the site slated for the September releases.

Our final task (or so we thought!) was to give the power tools a thorough workout clearing an area for a new work and storage shed. About half the concrete floor was poured for the shed, just as the rains accompanying Hurricane Charley started pouring ...

All the excitement of working with the Blue Iguanas plus a close encounter with a hurricane (!) was almost too much. With quick instructions from Fred Burton, everyone pitched in



RENOVATION ZONE
GRAND CAYMAN 2004

Illustration by Joel Friesch.

to prepare the facility to best withstand the high winds and torrential rains. Fortunately for the animals (and the island), little damage was done and, with a few cancelled outgoing flights, extra hands were available to set all the cages back up again.

The work was tough, the heat and the sun grueling, but we made a difference! And we're all already encouraging John to let us know about the next construction and repair field trip...

Joe Wasilewski

AJ Gutman

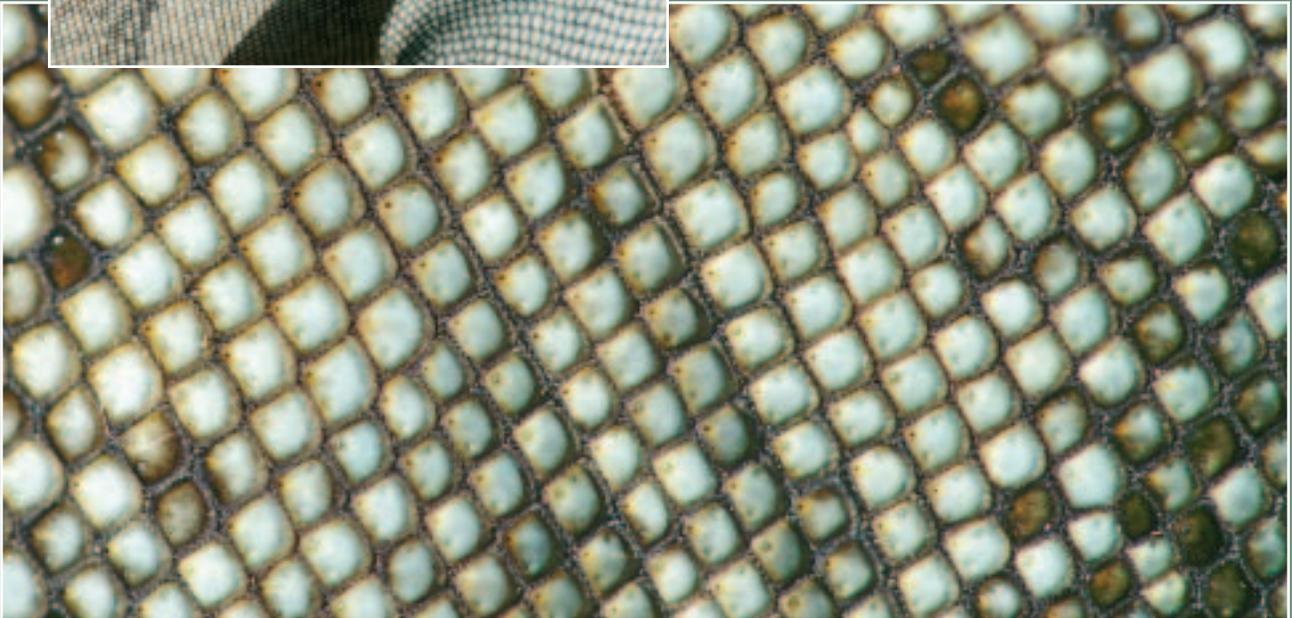


Young, sexually mature male *Cyclura lewisi*.

Viewed closely, the dark chevrons, a residual part of the juvenile pattern, are a mosaic of dark and pale blue scales.

See article on p. 148. *Photographs by Fred Burton.*

Closer still, the individual scales show paired pits whose detailed structure and function are apparently unknown, but may be widespread in the genus *Cyclura*.



Lesser Antillean Iguana, *Iguana delicatissima*, from St. Eustatius (see story, p. 138). Photograph by John S. Parmelee, Jr.

