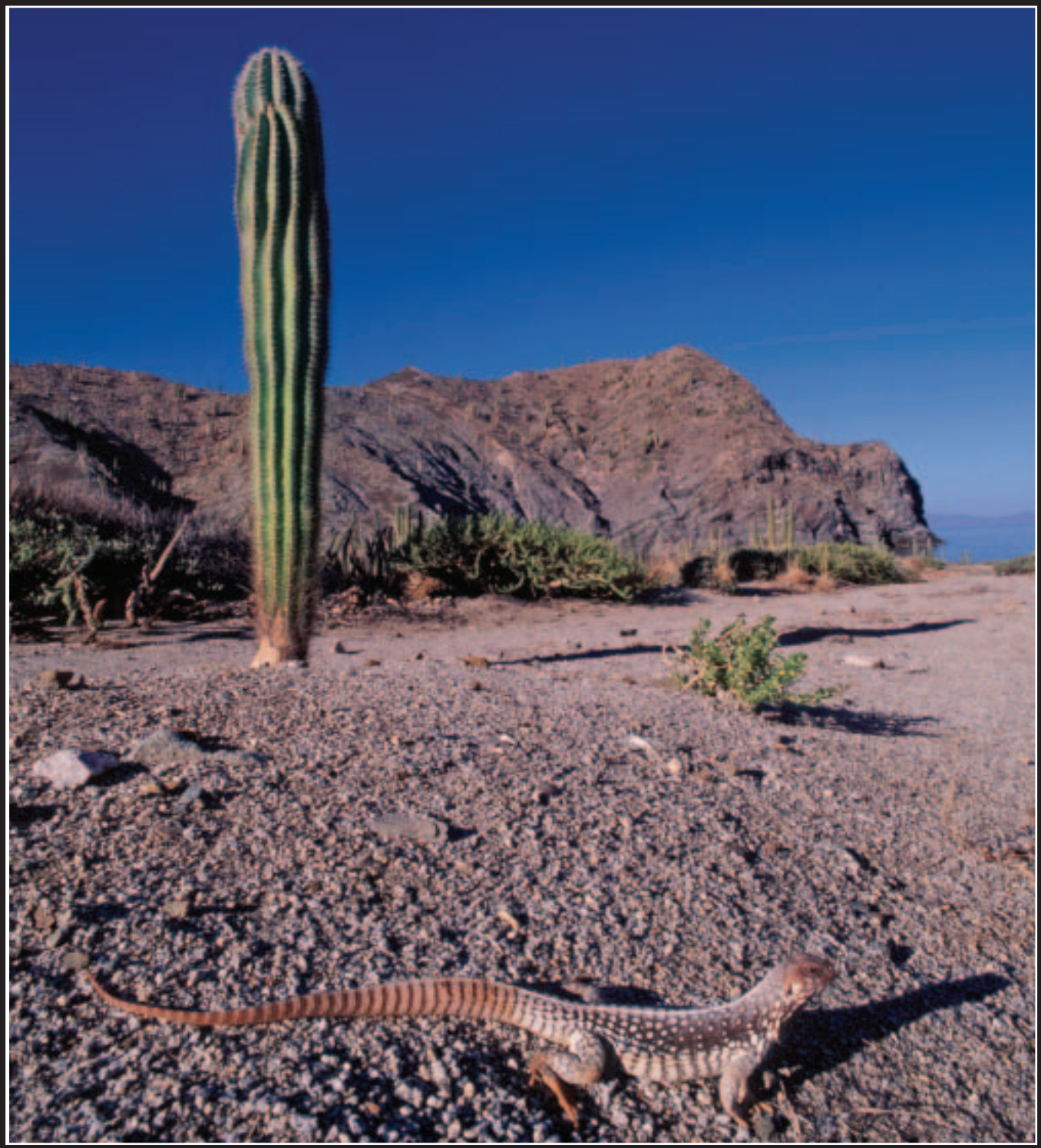
Volume 11, Number 1 March 2004 US$6.00

IGUANA

Journal of the International Iguana Society www.IguanaSociety.org



Dipsosaurus catalinensis, Isla Santa Catalina, Baja California Sur, México (see story on p. 2). *Photograph by L. Lee Grismer.*

Santa Catalina Island Desert Iguana (*Dipsosaurus catalinensis*): An evolutionary experiment in progress (see article on p. 2). *Photograph by L. Lee Grismer.*

Juvenile Black Iguana (*Ctenosaura similis*) from Parque Nacional Santa Rosa, Costa Rica (see article on p. 16). *Photograph by Robert Powell.*

Ricord's Iguana (*Cyclura ricordii*) from Parque Nacional Isla Cabritos, Dominican Republic (see related story on p. 8). *Photograph by Robert Powell.*

Healthy adult San Pedro Nolasco Black Iguana (*Ctenosaura nolascensis*) (see article on captive care of Black Iguanas on p. 16). *Photograph by John Binns.*

TABLE OF CONTENTS

FEATURES

HUSBANDRY

PROFILE

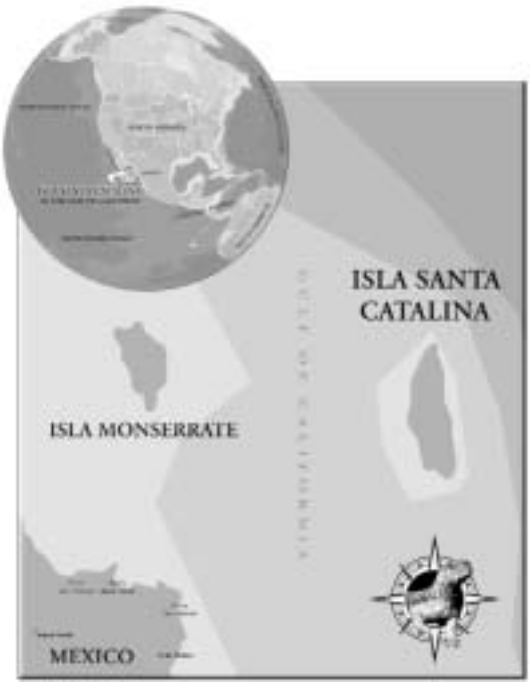
HISTORICAL PERSPECTIVE

BOOK REVIEWS

INDICES

Dipsosaurus catalinensis from Isla Santa Catalina, Baja California Sur, México.

Dipsosaurus dorsalis has a circum-Gulf of California distribution and is a popular symbol of southwestern desert ecosystems.



Gulf of California showing the location of Isla Santa Catalina. *Illustration by John Binns.*

Santa Catalina Island Desert Iguanas, *Dipsosaurus catalinensis*: An Evolutionary Experiment in Progress

L. Lee Grismer

Department of Biology
La Sierra University
Riverside, CA 92515–8247

All photographs by the author.

The islands in the Gulf of California, México are renowned for being among the most evolutionarily dynamic regions of North America. Indeed, studies of the flora and fauna of these islands have contributed significantly to much of what we currently understand about the evolution of insular ecosystems and insular biogeography. Reptiles have figured prominently in many of these studies, largely because they are represented in the Gulf of California by a number of endemic forms and adaptive types. Many of the iconoclastic species of North America's Sonoran Desert have given rise to insular populations in the Gulf of California that, for a variety of reasons, have attained full-species status subsequent to their isolation. The processes of sampling error, genetic drift, and the new selective pressures attendant with insular systems have driven many of these species to evolve into highly adapted, sometimes bizarre forms.

One of the most conspicuous species of lizards with a geographic range that coincides with the circum-gulf distribution of the Sonoran Desert is the Desert Iguana, *Dipsosaurus dorsalis*.

Dipsosaurus dorsalis has a distribution that borders much of the Gulf of California. This individual is from San Diego County, California.

Dipsosaurus catalinensis: note the short, blunt head, the constriction near the base of the tail, the colored tail, and the dark throat.

Its relatively large size, high density, docile behavior, and general lack of fear of humans has made this lizard a popular symbol of southwestern desert ecosystems and a relatively well-studied species — but, like many of its sympatric desert associates, the evolutionary history of *D. dorsalis* has been affected by the formation of the Gulf of California, and an isolated population of *Dipsosaurus* on Isla Santa Catalina off the eastern coast of Baja California Sur just south of Loreto, has attained species status.

This species, *Dipsosaurus catalinensis*, was named by John Van Denburgh in 1922 after the island on which it is found. In 1954, at a time when the concepts of species and subspecies were much different than they are today, this lizard was relegated to subspecific status within the *D. dorsalis* complex. Only in recent years, with the advent of a more accurate understanding of species boundaries has its original status been reestablished. However, unlike its mainland and peninsular counterpart and despite a considerable amount of herpetological research in the region, virtually nothing is known about the life history and ecology of this endemic species, making it one of the least known of all iguanas. Still, after only a few minutes on the island spent watching these lizards, the differences in morphology, color pattern, and behavior that separate them from *D. dorsalis* become quite evident.

Anyone familiar with *D. dorsalis* will be struck immediately by the distinctly shaped head of *D. catalinensis*. Its snout is shorter and more blunt than that of its mainland counterpart. This gives its head a relatively more square and an almost "stubby" appearance. The reasons for this are unclear. These lizards may be feeding differently or constructing burrows in a manner that is facilitated by the blunt head. Scientists lack any reasonable explanation, mainly because this species has never been studied.

Many Santa Catalina Island Desert Iguanas have a noticeably constricted base of the tail. Again, the reasons for this are unclear, and even the most reasonable attempts to explain it are highly speculative. Constricted tails usually are associated with fracture planes that facilitate tail loss (autotomy) and regeneration after attacks by predators or violent intraspecific interactions. However, this does not seem to be the case in this instance, as tail breakage frequently does not correspond to the constriction. Hatchlings and juvenile *D. catalinensis* have an orangish tail. Brightly colored tails in lizards frequently serve to distract predators from the more vulnerable heads and bodies,

Dipsosaurus catalinensis is found only on Isla Santa Catalina.

but the bright tail color in these young iguanas often serves as a target for aggression by other iguanas. What selective advantage could be served by the latter? Again, a question with no certain answer. Maybe the orange color does distract predators effectively, maybe even to the extent that the apparently deleterious responses generated in conspecifics are negligible in comparison. Certainly, colors in the red to orange portion of the spectrum are known to elicit strong reactions in many species of iguanas.

One of the most curious differences of this species, however, is its solid, chocolate-brown throat. This is most noticeable in males and probably has some function in courtship or aggression. Certainly, many other species of iguanas regularly use throat and dewlap colors to signal status or intent.

Behavioral differences are profound and very evident after even casual observations. Unlike its docile cousin, *D. dorsalis, D. catalinensis* is difficult to approach and aggressive when cornered. This wariness is somewhat of an anomaly because insular lizards in the Gulf of California generally exhibit much shorter flight distances than their adjacent peninsular counterparts — and the most common explanation for this phenomenon is that the island populations are subjected to less intense predation pressures. However, during early April 1992, I noted that, of approximately 90 lizards observed, 35–40% had freshly regenerated tails, suggesting that predation on this population may be quite high. That, of course, might account for their uncharacteristically long flight distances. As noted above, I also have observed a great deal of aggressive behavior among hatchlings and juveniles, which are commonly seen biting and chasing each other. The orange tail is the body part most frequently bitten, and the number of individuals in those age classes with broken or regenerated tails seems disproportionately high when compared to populations of many other lizards. Although tail breakage is common in young animals too inexperienced to effectively evade predatory attempts, the percentage of broken tails in a population usually doesn't reach the level seen in very young Santa Catalina Desert Iguanas until the lizards are much older.

Dipsosaurus catalinensis occurs both in the arroyo bottoms, where it takes refuge in the thornscrub, and on the rocky hillsides, where it usually retreats in crevices between or under rocks. These lizards generally are active throughout the year, but the least amount of activity occurs during fall and winter months, when most individuals seen are juveniles. Smaller lizards heat up more quickly and they are presumably able to utilize the relatively limited environmental sources of heat more effectively than older, larger animals.

As with most diurnal lizards, *D. catalinensis* emerges in the early morning to bask and then spends most of the remainder of the day going about other activities like courtship, territorial defense, and feeding. *Dipsosaurus catalinensis* is omnivorous and probably exploits opportunistically the most abundant seasonally available foods. At certain times of the year, finding groups

Isla Santa Catalina, Baja California Sur.

Some populations of *Dipsosaurus dorsalis,* are established on islands in the Gulf of California. These individuals are from Isla Cerralvo, Baja California Sur. Note the longer head, the lack of a constriction near the base of the tail, the tail colored as the body, and the light throat.

of two to six individuals feeding communally on the fallen fruits of Cardón Cacti (*Pachycereus pringlei*) is a common occurrence. This is most obvious where the cacti occur in stands. I once found a carcass of an individual with an intestinal tract filled to capacity with Cardón Cactus seeds. The seeds were mixed with several small rocks of the same approximate size. These appeared to be chipping away at the seeds' hard outer covering, serving much the same function as pebbles stored in the gizzards of seed-eating birds or the much larger gastroliths that have been found with fossilized remains of herbivorous dinosaurs. In the large intestine, essentially only the shells were left, as the fleshy pulps had been digested. I also have seen iguanas as high as one meter above the ground in Pitahaya Ágria (*Stenocercus gummosus*) feeding on ripened fruits.

Dipsosaurus catalinensis serves as a good example of how insular situations can produce sometimes substantive changes in organisms over even relatively short periods of time. Faced with unique selection pressures, different suites of predators and competitors, and reduced genetic variation, populations will do whatever they are genetically capable of doing to continue the lineage. In the case of *Dipsosaurus*, nature has taken a common, docile species and sculpted its descendants into wary and aggressive lizards. What selective forces were responsible for this change? Are they still operative today? Are similar pressures molding populations of other insular lizards? If so, are they eliciting results comparable to those observed in the Santa Catalina Desert Iguana or are they having profoundly different effects on populations of lizards with different genetic compositions and lifestyles? These are some of the interesting questions that evolutionary biologists could be asking about *D. catalinensis*. A modicum of fieldwork leading to even tentative answers might teach us a great deal about the evolution of insular systems in general.

Reference

Grismer, L.L. 2002. *Amphibians and Reptiles of Baja California, including its Pacific Islands and the Islands in the Sea of Cortés.* University of California Press, Berkeley.

SPECIES PROFILE

Banded Sand Snakes (*Chilomeniscus stramineus*)

Robert Powell

Avila University, Kansas City, Missouri

Sand Snakes in the genus *Chilomeniscus* have a circum-Gulf of California distribution very similar to that of Desert Iguanas (*Dipsosaurus*). Similar also is the association with sandy areas in open deserts, washes, and arroyos. Two species of Sand Snakes occur in the region: *C. stramineus* is most widely distributed and occurs on most of the Baja California Peninsula, in desert regions to the north and east of the Gulf, and on several Gulf Islands, whereas *C. savagei* occurs only on Isla Cerralvo.

Considerable confusion has clouded taxonomic relationships within the genus, most caused by the extremely variable patterns that range from distinctly banded to totally unicolored. Not until studies demonstrated that pattern variants coexisted at many localities was the clarification of relationships within the genus possible.

Sand Snakes are common in areas of loose soil and are an important component of many dune ecosystems. They are specialized for burrowing. A countersunk lower jaw and valved nostrils exclude small particles as these snakes "swim" through sand. Very smooth scales reduce friction both above and below the surface. Sand Snakes are nocturnal, but their abundance is obvious in some areas as a consequence of numerous tracks left in the sand by snakes that were actively foraging during the previous night. Sand Snakes apparently feed exclusively on small arthropods.

References

Grismer, L.L. 2002. *Amphibians and Reptiles of Baja California, including its Pacific Islands and the Islands in the Sea of Cortés.* University of California Press, Berkeley.

Grismer, L.L., H. Wong, and P. Galina-Tessaro. 2002. Geographic variation and taxonomy in the Sand Snakes, *Chilomeniscus* (Squamata: Colubridae). *Herpetologica* 58:18–31.

Chilomeniscus stramineus from near Loreto, Baja California Sur, México. *Photograph by Robert Powell.*

An adult *Cyclura ricordii* in a crevice in múcara east of "Los Olivares."

A two-year old juvenile *Cyclura ricordii* from the lower Barahona Peninsula.

Map of the Barahona Peninsula: The outlined area indicates where we were able to confirm the presence of *C. ricordii*. *Illustration by John Binns.*

Cyclura ricordii on the Barahona Peninsula: A Preliminary Report

Yvonne Arias, Sixto Incháustequi, and Ernst Rupp

Grupo Jaragua Inc., Santo Domingo, Dominican Republic

Photographs by Ernst Rupp.

Introduction

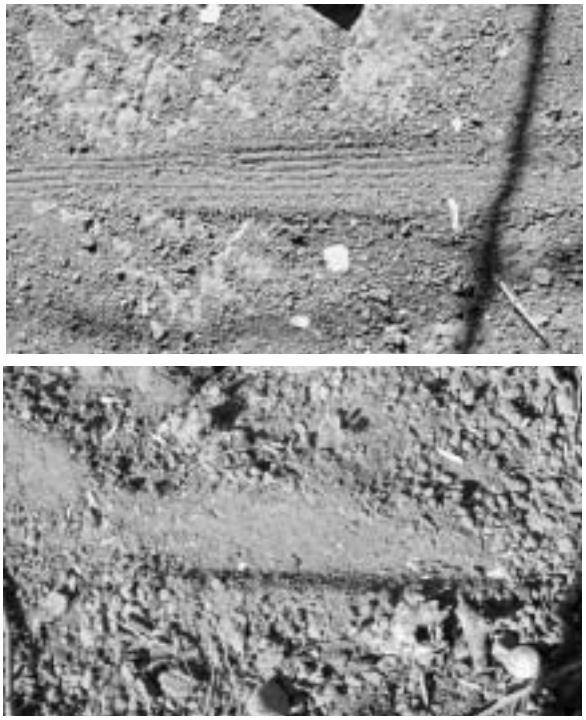
This report summarizes the preliminary results of the survey undertaken by Grupo Jaragua in the Cabo Rojo–Pedernales region of the Barahona Peninsula in the Dominican Republic. The main purpose of the survey was to search for and locate *Cyclura ricordii* habitats and populations in the region. We also assessed threats to the species and the extent of human impact on its populations.

Methods

We initiated fieldwork in December 2002 by identifying key informants and interviewing them about their knowledge of *C. ricordii*. We used photographs of *C. cornuta* and *C. ricordii* to determine if the informant was able to discriminate between the two species. These informants were persons who were known to have spent considerable time in the field and to have an extensive knowledge of the local flora and fauna. "Monteros," hunters of wild pigs and goats, and park rangers from Jaragua National Park were the best sources of information.

Subsequently, we made field trips to the sites identified by the key informants, where the presence or absence of *C. ricordii* was verified by the following methods: (1) Direct sighting with clear identification of an animal being *C. ricordii*. (2) Dead animals, when identification of parts being those of *C. ricordii*. (3) Tail drags: in the fine, reddish soil of the "fondos" (= level plains and depressions), the two species of iguanas leave distinctive tail drag marks. (4) Retreats: individual *C. ricordii* spend considerable time in close proximity to refugia. If an animal is sighted and identified, its retreat often can be found in the vicinity and drag marks also can determine the owner of a specific burrow. (5) Nesting sites: nesting activities of *C. ricordii* began in early April this year and females were active through May. During that period, no nesting activity of *C. cornuta* was verified. Consequently, all nesting attempts and finished nests found during those two months were attributed to *C. ricordii*. We also assumed that nests with signs of emerging hatchlings in July were those of *C. ricordii*. Using GPS (UTM, map datum: NAD 27 of the Caribbean), we recorded all localities where the presence of *C. ricordii* was verified.

In April 2003, we made a reconnaissance flight over the area via a helicopter generously provided by the Dominican Air Force. With experience gained during the fieldwork, we were looking especially for "fondos" that could serve as nesting sites of *C. ricordii*. We supplemented these efforts by using 1999 Landsat satellite images for the same purpose.



Tail drag of *Cyclura cornuta* (top, note the parallel lines) and tail drag of *C. ricordii* (bottom, note the lack of lines).

Results

General.—We verified the presence of *C. ricordii* in a small area (ca. 2 km^2) east of the town of Pedernales and in a larger area (ca. 32 km^2) north and east of the "Los Olivares" location. This area extends northeast to the Cabo Rojo–Aceitillar road.

We have also revisited the following areas: (1) All larger fondos and their surroundings east of the Cabo Rojo-Aceitillar road to an elevation of about 200 m asl (above sea level), (2) fondos and vicinities north and south of the Pedernales-Oviedo road between the 8 and 25 km markers, (3) the Bahía de las Águilas, (4) the Sabana de las Iguanas southeast of Cabo Rojo, (5) the

An active *Cyclura ricordii* burrow in the Fondo de la Malagueta (April 2003).

Vegetation in the Fondo de la Malagueta (October 2003).

Nesting attempts of a female *Cyclura ricordii* in a recently cleared and fenced terrain on the fringes of Los Olivares.

A gravid female *Cyclura ricordii* on múcara (limestone outcrops).

area "Ti Conserva" west of Tru Nicolá, (6) the area southeast of El Cerro, (7) "Cayo de las Iguanas" y "Cayo del Pey" in the Laguna de Oviedo, and (8) the western coast of the Laguna, directly opposite to the mentioned keys. We found signs of *C. cornuta* in all of these areas, but we were not able to verify the presence of *C. ricordii*.

Habitat.—The area limited to the southwest by the Pedernales-Oviedo road and to the east by the Cabo Rojo-Aceitillar road consists of flat plains punctuated by marine limestone terraces. Inside this area we found *C. ricordii* in a mosaic of habitats, which can be classified broadly into three categories: (1) **Fondo:** flat plains and depressions in the ground covered by fine argillic soil of reddish color. The vegetation is open canopy and certainly disturbed. The dominant species are: Cayuco (*Cephalocereus polygonus*), Alpargata (*Opuntia moniliformis*), Bayahonda (*Prosopis juliflora*), and Guasábara (*Cylindropuntia caribea*). During most of the year the ground was barren, but rains in September and October triggered rapid growth of herbs, grasses, and vines. Ricord's Iguanas excavate their burrows in the fondos, which also serve as major nesting sites. (2) **Múcara:** limestone rock outcrops (fig. 7), in which *C. ricordii* seems to show preference for less rugged areas, where holes and cracks serve as retreats. The extent to which Ricord's Iguanas are moving into the more rugged "dogtooth" limestone is unclear. The vegetation has an open canopy, but it is more diversified than in the fondos and the above mentioned species are less dominant. Bayahonda is scarce. (3) **Cascajo:** areas covered by gravel and small boulders. The vegetation seems to be a mixture of the elements that characterize múcara and fondos. After heavy rains, the ground is covered by herbs, grasses, and climbers. Ricord's Iguanas excavate nesting sites and burrows in cascajo.

At about 100 m asl toward the north, the vegetation becomes more dense, the canopy more closed, and the number of tree species more numerous. However, surface conditions can still be classified according to the three previously mentioned categories. *Cyclura ricordii* is present in these areas, and the sites where we found animals approach the limit of 150 m asl proposed by Ottenwalder (1999).

Distribution, Age Structure, and Population Densities.—The smaller subpopulation east of Pedernales includes animals of all age classes. Retreats are in múcara and cascajo. The area is characterized by having been used for slash and burn agriculture (conucism) in the past. Secondary vegetation, with strong presence of Guasábara, is dominant. We did not estimate *C. ricordii* population density because tracing transects in places heavily infested by Guasábara was impossible. *Cyclura cornuta* is present in the area.

"Los Olivares," an area subjected to intensive agriculture and apparently unsuitable for *C. ricordii*, separates the subpopulations. This area is a flat plain characterized by argillic reddish soil. Informants noted that Los Olivares supported a large population of *C. ricordii* before being converted into agricultural land. Aerial photos taken in 1983 showed that the eastern part of the area was still covered by natural vegetation. An irrigation channel built in 1984 also impedes the free movement of animals between the two subpopulations.

Aerial view of part of the outer fringes of "Los Olivares." Note the recent clearing of land in the upper center of the photo and the clearing, which is taking place in the lower right corner.

Aerial view of part of the northeastern fringes of "Los Olivares" showing the Pedernales–Las Mercedes road. Note the waste dump in the center of the photo and recent clearing of land close to the dump.

The larger subpopulation occupies an area that includes the outer fringes of Los Olivares towards the northeast, the marine limestone terraces that surround Los Olivares, and the plain above these limestone terraces. On the plain, one fondo of about 47 ha showed signs of very high Ricord's Iguana activity. This fondo, known locally as "Fondo de la Malagueta," is surrounded by patches of múcara, cascajo, and some smaller fondos. On an approximately 500 m-long transect (40 m wide) through the Fondo de la Malagueta, we counted 63 active burrows in May. Assuming that every active burrow is home to an adult animal, we calculated a density of 31.5 individuals per ha. The methods are certainly very crude and a more detailed investigation is appropriate, but the number gives an idea of the high density of adults in the fondo. We also noted the presence of juveniles and hatchlings. The incidence of *C. cornuta* seems to be low, with signs of activity limited to the southeastern corner of the fondo.

Estimates of population densities outside the Fondo de la Malagueta are more difficult. Based on the availability of suitable cracks and holes in the múcara, we assumed that population density was much lower than in the Fondo. Retreats are not as easily detected in múcara and cascajo as in the fondos. Also, both iguana species are present in this area, and no tail drag marks provided clues to the owners of specific retreats, forcing a reliance on direct observations. Reports by a key informant indicated that some retreats, which have been known over a period of years, had changed in ownership from one species to the other. The idea that suitable retreats in múcara might constitute a limited resource for both species is worth pursuing further.

A second fondo of about 25 ha is known locally as "Fondo de Robinson." In contrast to the Fondo de la Malagueta, we found no burrows. However, indications that the fondo may be an important nesting ground for both species were present. Various retreats of *C. ricordii* in múcara surrounding the fondo could be identified and several juveniles were sighted.

The northern fringes of the flat plain of Los Olivares, which lie adjacent to a limestone terrace, included various smaller localities with active burrows of *C. ricordii.* Part of the land is being cleared for agricultural use, so suitable habitat may soon be lost.

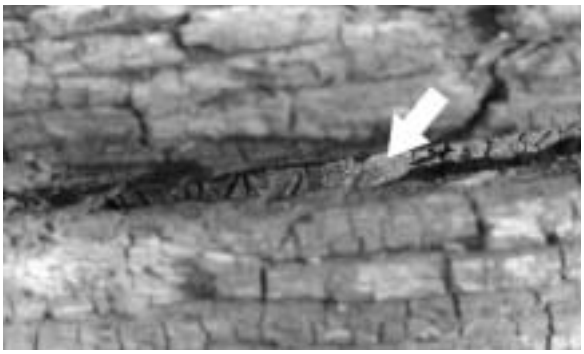
Nesting and Reproduction.—Female *C. ricordii* initiated nesting activities in early April 2003, possibly triggered by rain that fell in the area on 31 March and 1 April. On 8 May, we counted 28 finished nests along the 500-m transect in the Fondo de la Malagueta. We also confirmed nesting activities in the outer

A "finished" *Cyclura ricordii* nest.

A "finished" *Cyclura ricordii* nest in small fondo of about 1.5 x 1.5 m.

Hatchling *Cyclura ricordii.*

Successful hatching is indicated by the hole in this nest.



Hatchling *Cyclura ricordii* hiding inside a hollow log.

Effects of nest trampling by cattle.

fringes of Los Olivares and in many other smaller fondos. In fact, almost any suitable spot seemed to serve as a nesting site. Small fondos of only 1 m^2 contained finished nests. We even found evidence of nesting attempts and a few finished nests in some patches of cascajo.

On 10 July, we found the first nests with signs that hatchlings had emerged. On 20 July along the 500-m transect in the Fondo de la Malagueta, we counted 20 nests from which hatchlings had escaped during previous nights. A rough calculation of ten hatchlings per nest results in a density estimate of 100 hatchlings per ha. That same day, we captured two hatchlings that were hiding inside hollow tree logs on the ground. Considering the number of hollow logs and trees present in the fondo, the availability of suitable retreats may be a limiting resource for emerging hatchlings. The role of adjacent múcara in providing shelter to hatchlings in cracks and holes may be worth investigating.

We encountered nesting female *C. cornuta* in early July. They may have started nesting activities somewhat earlier, but no field trips were possible in June, so definitive data are lacking. Female *C. cornuta* nest in places which also are used by *C. ricordii*, and they start excavating nests before hatchling *C. ricordii* emerge. The impact of this behavior on the reproductive success of *C. ricordii* should be examined.

We only encountered two *C. cornuta* nests in the southeastern corner of the Fondo de la Malagueta. In the major part of the fondo, we found no evidence of nesting *C. cornuta*. *Cyclura ricordii* may have a competitive advantage for reproduction in this fondo.

Threats.—Exotic mammalian predators (e.g., mongooses and cats) are present in the area. We were unable to evaluate the magnitude of their presence and any resulting impact on populations of *C. ricordii*. We noted five free-ranging cattle in the area east of Los Olivares. Trampling of burrows or nests might be occurring. In a relatively small area like the Fondo de la Malagueta, even a minimal number of cattle could cause major damage.

However, habitat alteration and destruction by humans may be of greater concern than the presence of exotics. The area of Los Olivares may well have been a major center of activity for *C. ricordii* in the past. All of this area, except for its outermost fringes, has been converted into intensely used agricultural land. These outer fringes presently are also under pressure, and part of the terrain has been recently cleared of its vegetation. The areas where the two present subpopulations are found may already constitute only small remnants of the total distribution of the species once found in the area.

Trapping of iguanas and excavation of their burrows appear to be quite common in the outskirts of Pedernales. The northeastern fringes of Los Olivares also are affected by these activities. People in Pedernales eat iguanas, although the extent of the problem is unknown. We have submitted a proposal to study this phenomenon and its impact on iguanas to the Pittsburgh Zoo Fund.

The immediate surroundings of Pedernales, where iguanas still can be found, also are threatened by land clearings for housing development projects and a portion of the area is used as a waste dump.

Even an extension of the boundaries of the Jaragua National Park, which was proposed in 2002 under the "Proyecto de la Ley Sectorial de Áreas Protegidas" by the Secretaría de Estado de Medio Ambiente y Recursos Naturales, would protect only part of the area where we confirmed the presence of *C. ricordii*. The marine terrace, "Los Brujos," part of the outer fringes of Los Olivares, and the Fondo de Robinson would be excluded.

Recommendations

In light of the results cited above and fully aware of the critical situation faced by *Cyclura ricordii* in the Pedernales area, we propose the following:

(1) The area of "Los Brujos," including Fondo Robinson and the outer fringes of Los Olivares, should be included in the system of protected areas.
(2) Because the legal procedures necessary for the protection of *C. ricordii* will take time and final results are uncertain, direct measures should be implemented immediately.
(3) The type of landownership and the actual owners of the land that is most threatened by habitat destruction (i.e., the immediate surroundings of Pedernales and fringes of Los Olivares) should be determined. The acquisition of this land would serve to guarantee direct protection of the remaining habitat and facilitate restoration of degraded terrain.

Waste dump in the outskirts of Pedernales; *Cyclura ricordii* is known to occur in the area in the background.

A snare trap used by local inhabitants to catch iguanas.

Remains of a dead iguana that was killed for meat.

(4) Two persons should be employed to monitor the area where *C. ricordii* is present. These persons should be from the local community and should have an excellent knowledge of the terrain and the target species. They should control the persecution of iguanas and stop illegal habitat destruction by surveying the area, advising people regarding harmful practices, and reporting to the appropriate authorities, as necessary.
(5) The socioeconomic aspect of iguana hunting and consumption in Pedernales should be investigated.
(6) Educational programs must be developed that not only address the general public, but will serve to open a dialogue with the target group of persons in Pedernales involved in iguana persecution.

Reference

Ottenwalder, J.A. 1999. Ricord's Iguana, *Cyclura ricordii,* pp. 51–55. In: A. Alberts (comp. & ed), *West Indian Iguanas: Status Survey and Conservation Action Plan.* IUCN/SSC West Indian Iguana Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK.

Acknowledgments

We thank John Binns and Robert Powell for improvements on an early draft. We express gratitude to Máximo Aquino, Subsecretario de Recursos Forestales, Secretaría de Medio, Ambiente y Recursos Naturales, for logistical support and the Dominican Armed Forces for the helicopter flight. Special thanks go to Salvador P. Mella from Pedernales, who accompanied us in the field and whose knowledge of iguanas was invaluable.

SPECIES PROFILE

The Ground Lizards (*Ameiva*) of the Lower Barahona Peninsula

Matthew E. Gifford[1] and Robert Powell[2]

[1]Washington University, St. Louis, Missouri
[2]Avila University, Kansas City, Missouri

Photographs by Robert Powell.

The Lower Barahona Peninsula is that portion of the peninsula south of the Sierra de Baoruco. Because the region lies in the rainshadow of the mountain range, the lower elevations get little rain and are characterized by dry tropical forest. Until recently, four species of Ameiva were thought to occur in the region: *Ameiva chrysolaema, A. leberi, A. lineolata,* and *A. taeniura.*

Of the four, *A. lineolata* is the smallest (maximum known snout-vent length = 59 mm) and the most xerophilic (tolerant of harsh, dry conditions). This species, featuring a bright blue tail and feet, has a disjunct range in similar habitats across the island of Hispaniola. A*meiva taeniura* is intermediate in size (SVL to 103 mm), the least drought tolerant, and is restricted largely to the relatively few and scattered moist microhabitats. Although, at some sites, one can stand in one place and see individuals of different species, closer observation reveals that *A. taeniura* only rarely leaves the cooler, shaded areas where canopy cover is relatively dense.

In the same study that revealed the habitat association of *A. taeniura,* the authors found no significant differences in microhabitat use by *A. chrysolaema* and *A. leberi,* which are comparable in size (SVL to 160 mm in some populations). The former species is widely distributed across Hispaniola, whereas the latter is known only from the peninsula. They are distinguished in that the back and sides of *A. chrysolaema ficta,* the subspecies found in the area, is distinctly patterned, whereas A. leberi is unicolored. Because other populations of *A. chrysolaema* are known to have unicolored pattern variants and because no ecological differences were evident, the authors suggested that *A. chrysolaema* and *A. leberi* were, in fact, pattern variations of a single species. More recent genetic studies have verified that contention.

One of those studies also determined that *A. chrysolaema* from the peninsula was distinctive relative to populations elsewhere on Hispaniola. This is not surprising, because the island actually is a composite of two paleois-

Ameiva lineolata, with its distinct stripes and electric blue tail and feet, is the most drought-tolerant species.

Ameiva taeniura is least drought tolerant and is restricted to relatively moist microhabitats on the peninsula.

Peninsular *Ameiva chrysolaema* come in two pattern phases; this phase is characterized by distinct spots and bars.

The unicolored phase of *Ameiva chrysolaema* was until recently thought to be a distinct species, *A. leberi.*

lands that have become joined only recently, at least by geological standards. The Barahona Peninsula is part of the South Island, whereas most of Hispaniola is derived from the North Island. This, however, raises the additional questions of where *A. chrysolaema* originated and how the ancestors of today's lizards colonized the other paleoisland.

Only tentative answers are possible because genetic data from Haitian populations are missing and currently unavailable (due to the difficulties and dangers of conducting fieldwork in Haiti) and data from the Dominican Republic are inconclusive. Presumably, *A. chrysolaema* stock originally became established in the north. Descendants expanded their range into the lowlands to the south and east, and some of those migrating to the south apparently reached the South Island during one of the periods when sea levels were low and the intervening channel was exposed. Subsequently isolated by rising sea levels, the South Island population became distinct from its relatives to the north.

So, should *A. chrysolaema ficta* be considered a species separate from its North Island counterparts? Probably; but a definitive answer must await the analysis of Haitian material. In the interim, however, *A. chrysolaema,* as currently defined, probably is best and most accurately referred to as a "species complex," a group of closely related species in which the species boundaries often are poorly defined.

Since both *A. lineolata* and *A. taeniura* are found on both paleoislands, one has to wonder if further research will show a pattern similar to that which seems to best explain the situation in the *A. chrysolaema* complex.

References

Gifford, M.E., R. Powell, and R.L. Gutberlet, Jr. In review. Geographic variation in mitochondrial DNA haplotypes in a widespread teiid lizard (*Ameiva chrysolaema*) on Hispaniola. *Molecular Phylogenetics and Evolution.*

Hower, L.M. and S.B. Hedges. 2003. Molecular phylogeny and biogeography of West Indian teiid lizards of the genus *Ameiva. Caribbean Journal of Science* 39:298–306.

Schell, P.T., J.S. Parmerlee, Jr., and R. Powell. 1993. *Ameiva chrysolaema. Catalogue of American Amphibians and Reptiles* (563):1–6.

Schwartz, A. and R.W. Henderson. 1991. *Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History.* University of Florida Press, Gainesville.

Schwartz, A. and R.F. Klinikowski. 1966. The *Ameiva* (Lacertilia: Teiidae) of Hispaniola. II. Geographic variation in *Ameiva chrysolaema* Cope. *Bulletin of the Museum of Comparative Zoology* 133:425–487.

Sproston, A.L., R.E. Glor, L.M. Hartley, E.J. Censky, R. Powell, and J.S. Parmerlee, Jr. 1999. Niche differences among three sympatric species of *Ameiva* (Reptilia: Teiidae) on Hispaniola. *Journal of Herpetology* 33:131–136.

Black Iguanas (*Ctenosaura similis*), such as this subadult, are exceedingly arboreal in the Guanacaste region of northwestern Costa Rica. This may be attributable to the relative scarcity of Green Iguanas (*Iguana iguana*) in the area.

Black Iguanas (*Ctenosaura similis*) are much less arboreal throughout most of their range in Costa Rica, where they coexist with Green Iguanas (*Iguana iguana*). This adult female is basking on a fallen log at Parque Nacional Manuel Antonio.

Distribution of iguanas in Costa Rica: *Iguana iguana* (gray circles), *Ctenosaura similis* (white circles), and *C. quinquecarinata* (squares). The latter is restricted to the northern part of Guanacaste Province in extreme northwestern Costa Rica. This map was adapted by John Binns from distribution maps provided in Savage (2002. *The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas.* University of Chicago Press, Chicago, Illinois).

Black Iguanas (*Ctenosaura similis*) in Guanacaste, Costa Rica

Robert Powell

Avila University, Kansas City, Missouri

Photographs by the author except as indicated.

Three species of iguanas are native to Costa Rica: the Common or Green Iguana (*Iguana iguana*), the Black Iguana (*Ctenosaura similis*), and the Five-keeled Black Iguana (*Ctenosaura quinquecarinata*). Green Iguanas may exceed 2 m in total length, and larger adults in particular are almost exclusively arboreal. These lizards occupy Neotropical lowlands from Sinaloa and Veracruz, México through Central America to Ecuador on the Pacific versant and to Bolivia, Paraguay, and south-central Brasil on the Atlantic slopes. Other populations occur on some Lesser Antillean islands (see IGUANA 10(3), p. 71). The species also has become established in areas as geographically diverse as Puerto Rico, Florida, and Hawaii, primarily as a consequence of human agency (see IGUANA 10(4), p. 111). In Costa Rica, the species remains relatively common to elevations up to 500 m in lowland rainforests and gallery forests of both the Caribbean and Pacific versants. In drier areas, such as much of the Guanacaste region, however, this species is largely restricted to riparian situations.

Black Iguanas reach total lengths of about 1.3 m. These lizards are found in lowlands and lower premontane areas from the Isthmus of Tehuantepec eastward and southward on the Pacific versant to central Panamá and on the Atlantic versant to eastern Honduras, with scattered records in Costa Rica and central Panamá. *Ctenosaura similis* also has become firmly established in southern Florida (see IGUANA 10(4), p. 111). In Costa Rica, the species is locally abundant at elevations to 765 m in the Pacific lowlands. A single record in the Atlantic lowlands suggests that the species occurs there or may have formerly ranged up the valley of the Río Grande de Tárcoles. Ctenosaurs often adapt well to habitats altered, sometimes substantially, by humans. They occur in vacant city lots, gardens, cemeteries, junk piles, and rock walls or fence rows along cultivated fields. In more natural settings, they generally seem to prefer relatively open locations with rocky outcrops, fallen logs, or standing hollow snags. Black Iguanas are the most commonly observed iguanas in Costa Rica.

Three species of iguanas occur in Costa Rica: *Iguana iguana* (left), *Ctenosaura similis* (center), and *C. quiquecarinata* (right). *Photographs by R. Wayne Van Devender.*

Juveniles of the three species of iguanas that occur in Costa Rica: *Iguana iguan*a (left), *Ctenosaura similis* (center), and *C. quiquecarinata* (right). *Photographs by R. Wayne Van Devender.*

Black Iguanas throughout most of the Costa Rican lowlands tend to perch low to the ground. For example, this female *Ctenosaura similis* at Parque Nacional Manuel Antonio is basking less than one meter above the ground.

One of the very few *Ctenosaura similis* observed on or near the ground in Guanacaste was this juvenile at Parque Nacional Santa Rosa. When disturbed, it hid in low vegetation instead of climbing a nearby tree. *Photograph by Michael Powell.*

Five-keeled Black Iguanas are relatively small, reaching a maximum total length of less than 500 mm. The species has a disjunct distribution in semiarid and subhumid areas in lowland forests of Pacific slopes. Populations are known from southern Oaxaca, México, west-central Nicaragua, and northwestern Costa Rica. Although Nicaraguan animals reach elevations of 600 m, no Costa Rican population is known to occur above 145 m. In Costa Rica, this species is restricted to lowland dry forests in the extreme northwestern corner of the country.

The Guanacaste region is situated in northwestern Costa Rica. Most of the area consists of a relatively dry, undulating plain. Because of prolonged dry periods, rivers exhibit marked seasonal differences in volume and silt load. The dry forests tolerate five or six months with less than 100 mm of precipitation. Mean monthly temperature highs are over 30°C throughout the year and approach 35°C during the height of the dry season. Mean monthly temperature minima only rarely drop below 20°C. Although severely impacted by human activities, the remaining dry tropical forests have only two strata, with the higher canopy trees reaching 20–30 m. These tend to have short, stout trunks and large, spreading crowns, which often fail to contact each other. Understory trees are 10–20 m tall and have slender, crooked trunks and open crowns. Canopy trees are deciduous, whereas some understory species are evergreen. Shrubs are stunted and most species are notable for their thorns or spines. Woody, but not herbaceous, vines are common. Epiphytes are occasional, with bromeliads most abundant.

At least some of the Guanacaste populations of *C. similis*, particularly in non-riparian situations, utilize habitat resources in strikingly different ways than conspecifics elsewhere in Costa Rica. Presumably because of the prevailing dry conditions, Green Iguanas are largely restricted to areas along streams and are rare or entirely absent from much of the region. Consequently, the arboreal niche utilized by that species in other parts of the country is available — and it is extensively and effectively exploited by *C. similis*.

During a recent visit to the Guanacaste region (November–December 2003), I saw only one juvenile on a pile of logs and one adult female foraging on the ground for fallen yellow blossoms. In contrast, literally dozens of lizards of all age

Individuals like this very dark *Ctenosaura similis* from near Playa Hermosa, Guanacaste Province, provide meaning for the common name, Black Iguana.

I observed this very large male *Ctenosaura similis* from near Playa Hermosa defend his territory against another male and court a female while never descending to within 15 m of the ground.

Opportunities for thermoregulation abound in arboreal habitats; this adult female *Ctenosaura similis* from near Playa Hermosa sought deep shade during the heat of the day.

This subadult *Ctenosaura similis* from near Playa Hermosa was on the ground feeding on fallen flowers, but immediately sought shelter in a nearby tree when disturbed.

Ctenosaurs basking high in trees were a common sight. In the course of the day, individuals would adjust their positions to exploit patches of sun penetrating through the upper canopy.

At least some individuals adapt readily to habitats provided by humans; however, I saw no iguanas on roofs or other man-made structures that were not accessible from adjacent trees.

classes were high in trees, where they were quite effectively mimicking behaviors I normally associate with Green Iguanas. I observed territorial defense, courtship, mating behavior, and competition for prime basking sites. Also, the locals with whom I spoke about iguanas indicated that "iguanas negras" were found in trees. My contention that the populations of *C. similis* in this area are much more arboreally inclined than others I have encountered was reinforced when the female that had been foraging on the ground was disturbed and immediately ran to and climbed the nearest tree. This stands in stark contrast to escape behavior I have observed in populations of *C. similis* elsewhere in Costa Rica or in other parts of the species' range, where individuals almost invariably seek shelter in excavated burrows or in hollow logs and snags.

The concept of "ecological release" is used to describe situations in which a population of plants or animals becomes capable of exploiting a resource not usually available due to competition, often with closely related and ecologically similar forms. However, ecological release does not typically entail an almost complete shift from one resource to another, such as that which I observed in *C. similis* in at least some parts of the Guanacaste region. Because I was unable to assess habitat associations throughout the year or even in weather other than the unusually cool, damp conditions I encountered at the very end of the rainy season of 2003, I am unable to state with any authority whether ecological release is evident or some other, possibly transitional factors were operative. Nevertheless, my observations suggest that interactions between *C. similis* and *I. iguana* might be far more complex than has generally been assumed, and that the habitat partitioning that is usually evident may reflect an effort to avoid competition as much as any preferences on the parts of the species involved.

References

Köhler, G. 2002. *Schwarzleguane: Lebensweise, Pflege, Zucht.* Herpeton, Verlag Elke Köhler, Offenbach, Germany.

Savage, J.M. 2002. *The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas.* University of Chicago Press, Chicago, Illinois.

SPECIES PROFILE

Asian House Gecko (*Hemidactylus frenatus*)

Robert Powell

Avila University, Kansas City, Missouri

House Geckos in the genus *Hemidactylus* are widely distributed throughout the tropics and subtropics of the Eastern Hemisphere. As the common name implies, they often function as human commensals. Consequently, these lizards are particularly prone to "hitch-hiking," and several species have become established in the Americas. At least three forms, *H. haitianus* in the Greater Antilles, *H. leightoni* in Colombia, and *H. palaichthus* in northeastern South America, have diverged sufficiently from their ancestors to be considered endemic Neotropical species.

Hemidactylus turcicus, native to the Mediterranean region, is common in the southeastern United States. It has expanded its range considerably after presumably arriving originally in Florida. At least one individual found its way to Missouri in a travel trailer purchased in Florida. *Hemidactylus garnotii,* of the South Pacific, is firmly entrenched in Florida and has established satellite populations throughout the New World. *Hemidactylus mabouia,* originally from sub-Saharan Africa, is widely distributed in eastern and northern South America and much of the Caribbean area. It has recently become increasingly common in southern Florida and apparently is displacing *H. turcicus* in most of the southern peninsula. Its passage across the Atlantic from Africa may have predated human traffic. The most recently established newcomer is the Asian House Gecko, *H. frenatus.* All of these species are effective colonizers that either have or are currently expanding their ranges, "leap-frogging" from port to port or city to city in baggage or freight or as eggs in plants and shipments of lumber.

The site of the first established population of *H. frenatus* in the Western Hemisphere is unknown, but the species has quickly become abundant throughout much of the Neotropics, in some areas apparently displacing related species that had become established years earlier. As recently as the mid-1980s, this species was unknown in Costa Rica. By the early 1990s, it had become ubiquitous in towns and resorts of the Pacific Lowlands and is now found in Caribbean ports and several inland localities, suggesting that range expansion is ongoing.

Although individuals occasionally are found in natural habitats, House Geckos usually associate closely with humans. They are abundant in almost any type of structure, gathering in large numbers to feed on insects attracted to neon lights of business establishments or emerging at night from light fixtures and from behind picture frames to forage on walls and ceilings.

References

Lever, C. 2003. *Naturalized Reptiles and Amphibians of the World.* Oxford Univ. Press Inc., New York.

Savage, J.M. 2002. *The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas.* University of Chicago Press, Chicago, Illinois.

An adult *Hemidactylus frenatus* on a television screen in Jaco, on the Pacific Coast.

The Last Dozen

Lutz Dirksen, Director

Iguana Research and Breeding Station, Utila

Once again, juvenile Utila Spiny-tailed Iguanas, known as Swampers (*Ctenosaura bakeri*), are ready to be released into the wild on the Honduran island of Utila. An expedition is prepared to Iron Bound, where the gravid females first surrendered their eggs. Barely 20 months ago, the tiny Swampers squirmed and wriggled their way out of paper-thin eggshells that were becoming too snug. An eggtooth is a handy tool for that kind of job. After hatching, everything was wonderfully warm — after all, the incubators were set for 30 °C. The vermiculite was soft and pleasantly moist — but something wasn't right. Naturally, the little Swampers couldn't know that their very first impulse upon hatching involved a genetic fixation on scrabbling up out of a nest hole that could be as much as 40 cm deep in the sand. Barely had the little iguanas calmed down (since nothing was really amiss), when two large hands reached for the delicate little creatures to weigh, measure, and mark them. They then were placed in cages, from which half of the hatchlings were abruptly carried off to Iron Bound to be released. A year later, a large number of the remaining iguanas were released to the wild, and only 12 remained at the Iguana Research and Breeding Station, which is supported largely by the Zoologische Gesellschaft Frankfurt and the Senckenbergische Naturforschende Gesellschaft.

These 12 Swampers originally were to be equipped with microchips. However, the equipment was unavailable and the decision was made to release the final dozen from the 2002 hatch. Of course, the 12 iguanas were weighed and measured again, had toe-codes read, and femoral pores counted. Then they were packed into cloth bags, resisting in vain with tooth and claw.

Iron Bound is an unspectacular stretch of coast made up of volcanic and coral rock. The small bay with a patch of sandy beach is shrugged off by humans as being too dangerous for swimming due to the sharp-edged rocks. The Swampers, however, care

This healthy young male, photographed moments after release, is testament to the quality husbandry and care provided during the short captive period. *Photograph by Lutz Dirksen.*

The enclosures are in a natural setting and provide ample space for the growing iguanas until they are large enough to be released into the wild. *Photograph by John Binns.*

Iron Bound's coast is lined with palm trees, sandy pockets, and rugged volcanic and coral rock. *Photograph by Lutz Dirksen.*

Hatched and raised in captivity until he reached the size at which predation pressure is minimal, this young adult male Utila Iguana views his natural home in the swamps of Utila for the first time. *Photograph by Lutz Dirksen.*

Excited Utila Iguana Station volunteers release the iguanas where the swamp meets sandy beach of Iron Bound.Volunteers are not funded and pay their own expenses to participate in saving these iguanas. *Photograph by Lutz Dirksen.*

only for what lies beyond the craggy water's edge – the sand, critical for their survival, and the mangroves that begin 100 m from the sea. In the mangroves, Fiddler Crabs scurry underfoot trying to reach their holes in the sand before they are flattened. This spot is ideal for leaving the little Swampers to fend for themselves. They have been fed regularly on mangrove leaves and Fiddler Crabs, as these make up the bulk of their diet in the wild.

The cloth bags are untied one after another, and little heads are followed by the bodies of the rather confused juveniles. Some immediately dart off, but most just look around, not initially comprehending that they are free at last — or that they now have to find food on their own. Slowly they move off in all directions. A particularly intrepid young Swamper scales a tree, where he seems startled at being driven away by one of his wild relatives. Clearly the rules are different here than in the cages at the Station. Here, bitter battles are fought for every scrap of good territory and every available tree hole. No wire mesh keeps the juvenile Swampers safe from predators. Nevertheless, they are not as small and vulnerable as their brothers and sisters released before them. In no time at all, the final 12 will adapt to their lives in the mangroves.

This release included a very special Utila Iguana named "Buddy," who was adopted under the Utila Iguana Adoption Program in December 2003 by John and Sue Porubek.

If you would like to be part of this story, the Station is continually seeking new volunteers, so that the same drama can be repeated again next year.

An Update on the Ecology and Conservation of *Cyclura pinguis* on Anegada

Glenn Gerber

Center for Reproduction of Endangered Species
Zoological Society of San Diego

All photographs by John Binns, unless otherwise indicated.

Adult Anegada Iguanas (*Cyclura pinguis*) can grow to be more than 1.3 m in length and 7 kg in weight, making them among the world's largest lizards. Unfortunately, with only a few hundred animals remaining in the wild, Anegada Iguanas also are among the world's most endangered lizards. Although remains of the species are known from Pleistocene cave deposits on Puerto Rico and Native American middens on Saint Thomas, the only population remaining at the time of European colonization of the West Indies was on the 39-square-kilometer island of Anegada in the British Virgin Islands (BVI). Since then, increasing pressures from people and their domestic animals have driven the iguana population on Anegada to the edge of extinction. Human developments destroy habitat, feral livestock (including cattle, donkeys, and goats) severely over-browse the native vegetation on which iguanas rely for food, and feral cats eat all but a few hatchlings each year. As a result, the iguana population on Anegada has been declining for decades, if not centuries, and now occupies only a small fraction of the island and is composed almost entirely of aging adults.

Fortunately, those iguanas lucky enough to reach maturity stand a good chance of living a long life, perhaps 40–60 years. This longevity may explain why the species has persisted as long as it has in the face of all these threats. Still, unless the number of juveniles that survive to produce young of their own can be dramatically increased, the iguana population on Anegada is doomed to extinction. To prevent this, habitat will have to be protected and restored, and feral mammals, particularly cats, will have to be controlled. Implementing such measures can be a difficult and lengthy process, even on a relatively small island. Until these long-term goals can be met, we have embarked on a conservation strategy called headstarting to bolster the population in the short-term. Headstarting involves collecting juveniles from the wild just after they hatch and raising them in a protected, captive environment until they are large enough to survive in the wild.

The Anegada headstarting program was initiated in 1997 as a collaborative effort between the British Virgin Islands National Parks Trust (BVINPT), the Fort Forth Zoo, and the Zoological Society of San Diego. In addition, ecological studies of the remaining wild population have been underway since 1998 to aid in the collection of juveniles for the headstarting program and to learn more about the population's status, distribution, and reproduction. These studies have revealed that the population, although heavily skewed towards adults, has an even sex ratio and is still reproductively viable. Out of 33 adults captured and marked in 1998 and 1999, 16 were male and 17 were female. Nests have been found every June and July since 1998 and hatching success has been very high. Once located, nests are fenced off to exclude feral mammals and to facilitate the collection of hatchlings for headstarting when they emerge in September or October. Because of these efforts, over 80 juveniles are currently in the headstart facility, which has expanded over the years from a single cage to 13 enclosures. What follows is a summary of project activity for the past year.

Release of Headstarted Iguanas

In 2003, many of the older juveniles in the headstart facility began reaching a size at which we felt they could survive in the wild with cats. As a result, the first release of headstarted iguanas on Anegada took place in early October 2003, funded by a grant from the International Iguana Foundation. Twenty-four iguanas were released: 12 males and 12 females ranging from 4–6 years in age, 0.8–2.5 kg in weight, and 235–300 mm in snout-vent length. The animals were released at two sites in the core iguana area that supports breeding adults. Half of the animals were released in a coastal area with sandy scrub and half were released in an inland area with rocky woodland. Prior to release, veterinary staff from the Fort Worth Zoo examined all of the animals to ensure that they were healthy and surgically implanted radio transmitters so that they could be monitored after release. Kelly Bradley of the Dallas Zoo is tracking and studying the released animals for her M.S. thesis research at the University of Texas–Arlington. All animals were located daily for the first three weeks following release, again for two weeks in late November and early December 2003, and most recently for two weeks in mid-January 2004. Two of the animals died of unknown causes soon after release: a medium sized female was found dead a few days after release with her incision reopened, and the transmitter belonging to a small male was found in late November near his last known location in October. The remaining 22 animals are all doing well, giving a 3-month post-release survival rate of 92 %. This is excellent considering that all of these animals would likely have been killed by cats shortly after hatching had they not been taken into the headstart program. In late

Northwest road near Cow Wreck where iguanas were not found in 2003.

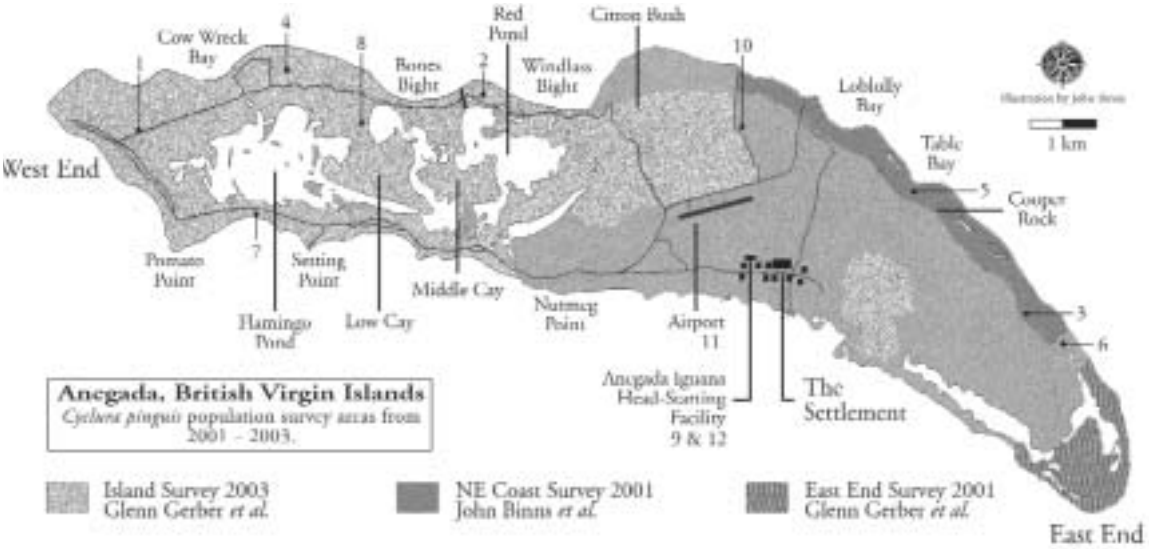
Glenn Gerber in Bones Bight, the core iguana area.

Habitat north of East End appears suitable, but no iguanas were found in 2001.

Joe Burgess and Roberto Maria during the 2003 survey east of Cow Wreck.

Sandy Binns at Table Bay during the 2001 survey of the northeastern coast.

The area southeast of Cooper Rock is replete with livestock but devoid of iguana signs.



Neptune's Treasure provides excellent accommodations for researchers while on Anegada.

Lee Vanterpool, Roberto Maria, Joe Burgess, George Waters, and Glenn Gerber in 2003.

The Anegada Iguana head-starting facility is located next to the fire and police stations.

Livestock is a common sight along all roads on Anegada.

Joel Friesch, Alberto Alvarez, Juliann Sweet, and Sandy Binns departing Anegada in 2001.

One of the older head-started *Cyclura pinguis* prior to release in October 2003.

November, approximately six weeks after release, all 22 animals were briefly recaptured so that they could be weighed and measured. All of the animals were healthy and robust, with an average weight gain of 100 g. To date, animals have dispersed 13–390 m from their respective release sites. All of the iguanas have established small home ranges and are exhibiting retreat site fidelity. Focal animal observations are being conducted to determine how the animals are behaving and adapting to living in the wild after spending the first 4–6 years of their lives in captivity. Data are being collected on diet, habitat use, activity periods, and interactions with wild adults and other released iguanas. These data will be used to construct energy budgets for the released iguanas. Future trips to Anegada to continue monitoring the released animals are planned for March, May, and July 2004, and in October another 24 headstarted animals will be released and monitored.

Population Survey

A team consisting of John Binns (IRCF), Kelly Bradley (Dallas Zoo), Joe Burgess (IIS), Glenn Gerber (San Diego Zoo), Roberto Maria (ZooDom), Tarren Wagener (Fort Worth Zoo), and George Waters (IIS) conducted a population survey of *Cyclura pinguis* on Anegada in 2003 in an effort to obtain an accurate population estimate for this critically endangered species. The survey was conducted in July to coincide with the nesting season, and thus also provided a chance to locate active nests, adding to the reproductive database and aiding in the collection of juveniles for the headstarting program. Due to time constraints, efforts were concentrated on the western half of Anegada, which is believed to support the majority of the existing population. The survey consisted of walking line transects in groups of 2–4 people. Two types of line transects were conducted: simple transects, where meandering straight lines were walked and the number of iguana observations were recorded, and distance sampling transects, where straight lines were walked and the perpendicular distance of each iguana observation from the line was recorded. Distance sampling transects are more difficult and time consuming than simple transects, but allow for the computation of density estimates if a large enough sample can be obtained. Because time was limited, distance sampling transects were only walked in the core iguana area, which is located along the north-central coast of western Anegada, where iguana sightings were most likely. Simple transects were walked in all areas of western Anegada, including the core area. The intent behind this sampling strategy was to correlate relative abundance estimates obtained in the simple transects with density estimates from the distance sampling transects to arrive at an overall measure of iguana abundance for western Anegada. The location, path, and length of all transects walked were mapped using GPS, and all observations of iguanas and their retreats, tracks, and scat were

This *Cyclura pinguis* was returned to the wild in October 2003; he has been tracked by radio telemetry since his release. *Photograph by Rick Hudson.*

recorded. While walking simple transects, the team also recorded observations of feral mammals and their scat.

Unfortunately, only 13 observations of iguanas were made while walking distance sampling transects, too few to reliably estimate iguana density. Thus observations from both transect types are combined here and presented as a measure of relative abundance. Survey teams walked a total of 42.7 km of transects and observed a total of 24 iguanas, 63 iguana feces, 89 iguana retreats, and 172 iguana tail drags. With the exception of two iguana tail drags found near the southwestern shore, all of these observations were in the core area, which encompasses only 2.5–3 km^2. On average, only one iguana was observed per km of transect walked. The density of iguanas is very low within the core area and approaches zero outside the core area. In comparison to iguanas, evidence of feral livestock was abundant in the core area and throughout western Anegada. In 35.2 km of simple transects walked, the survey team recorded in excess of 1500 cattle feces, 700 donkey feces, and 150 goat feces. Although eastern Anegada was not included in this survey, prior work there turned up little evidence of iguanas and feral livestock appear to be even more abundant than in the west. These findings, combined with recent habitat destruction in the core area caused by land clearing, suggest that the iguana population on Anegada is becoming increasingly restricted in area and size.

Nesting

During the July survey, four recently closed iguana nests were located. All of these were in sandy areas of Windlass Bight and Bones Bight in the core iguana area. The nests were marked and later enclosed by BVINPT staff. Twenty-eight healthy hatchlings from these nests were collected and transferred to the headstart facility in October. Plans are underway to locate new nests in July 2004, so that the headstarting effort can be maintained as long as needed. This July, we also hope to observe nesting by some of the larger headstarted females released in 2003.

One of the very large adults observed on Middle Cay during the July 2003 survey. *Photograph by Joe Burgess.*

Glenn Gerber collecting a scat sample during a distance sampling transect in July 2003.

Education

Lee Pagni, a conservation education specialist, facilitated the initiation of an education program on Anegada in 2003. He surveyed approximately 30% of the adult residents of Anegada to determine their perceptions of, and support for, several important iguana conservation measures. Results of the survey are now being used to tailor a conservation education program for Anegada's citizens to increase public awareness and support for conservation initiatives. Plans for the coming year include production of a biannual iguana conservation newsletter for local distribution, development of interpretive materials for the headstart facility, and an educational program for local school children. Only with the long-term support and enthusiasm of the local community on Anegada will this unique iguana's future be secure.

Acknowledgments

In the past year, this project has received funding from the Chicago Board of Trade Endangered Species Fund, Chicago Herpetological Society, Cleveland Metroparks Zoo, International Iguana Foundation, John Ball Zoo, Morris Animal Foundation, Pittsburgh Zoo, and Roger Williams Park Zoo. The British Virgin Islands National Parks Trust, Dallas Zoo, Fort Worth Zoo, and San Diego Zoo have provided substantive technical, logistical, and financial support. John Binns, George Brown, Joe Burgess, Kim Harding, Rick Hudson, Jeff Lemm, Roberto Maria, Kerri Mitchell, Lee Pagni, Tarren Wagener, Joe Wasilewski, and George Waters provided field assistance. Allison Alberts, Rick Hudson, and the IUCN/SSC Iguana Specialist Group have been instrumental to this project from its inception. Finally, Kelly Bradley deserves special recognition for her dedication to the recent tracking studies on Anegada.

A Report on the IUCN/SSC Iguana Specialist Group 2003 Meeting

Providenciales, Turks & Caicos Islands

John Bendon

Bath, England

The seventh annual meeting of the Iguana Specialist Group was held in November 2003 in Providenciales ("Provo" to the locals) in the sunny Turks and Caicos Islands. Twenty-two representatives from the group met with officials from the TCI National Trust and the Department of Environment and Coastal Resources (DECR). Michelle Fulford-Gardiner, DECR, welcomed the group and stressed the importance of iguanas in the context of both biology and ecotourism. Allison Alberts, San Diego Zoo Center for Reproduction of Endangered Species (CRES), and Rick Hudson, Conservation Biologist, Fort Worth Zoo, served as moderators. Glenn Gerber, San Diego Zoo CRES, who currently is working with the endemic Turks & Caicos Iguana (*Cyclura carinata carinata*), was responsible for the venue and for organizing the development of a Conservation and Management Plan for *C. c. carinata*. Fred Burton, Blue Iguana Recovery Programme, and Quentin Bloxam, Durrell Wildlife Conservation Trust, facilitated the conservation planning workshop held immediately following the ISG annual meeting.

Taxon Updates

Reports (see "abstracts" on p. 29) on current projects were given by John Iverson (Earlham College) on *Cyclura cychlura inornata* from the Exuma Islands, Fred Burton on *Cyclura lewisi* on Grand Cayman Island, Rick Hudson (for Peter Vogel, University of the West Indies) on *Cyclura collei* in Jamaica, Miguel Garcia (Puerto Rico Department of Natural and Environmental Resources) and Nestor Pérez (University of Puerto Rico–Río Piedras) on *Cyclura cornuta stejnegeri* on Isla Mona, Chuck Knapp (University of Florida and the John G. Shedd Aquarium) on *Cyclura cychlura* and Andros Island, Glenn Gerber and Kelly Bradley (Dallas Zoo) on *Cyclura pinguis* on Anegada, Lee Pagni (San Diego Zoo) on attitudes and perceptions regarding the conservation of the Anegada Iguana, Jan Ramer (Indianapolis Zoo) on *Cyclura ricordii* in the Dominican Republic, Victor Hugo Reynoso (The Technical Consulting Subcommittee for the Conservation, Management, and Sustained Exploitation of Iguanas in Mexico) on Mexican iguanas, Peter Harlow (Taronga Zoo) on Fijian iguanas (*Brachylophus fasciatus* and *B. vitiensis*), Glenn Gerber and Allison Alberts on *Cyclura carinata carinata* in the Turks & Caicos Islands, Rick Hudson (for Robert Powell, Avila University) on Lesser Antillean iguanas, and Quentin Bloxam and Karen Graham (for Matthew Morton, Durrell Wildlife Conservation Trust) on St. Lucian *Iguana iguana*.

Conservation Management Strategies

Reports on ongoing management strategies included: (1) Jeff Lemm is making headway on a husbandry manual for West Indian iguanas. The group decided that the manual should be translated into Spanish upon completion. (2) The Morris Animal Foundation grant for *Cyclura* baseline health profiles was reviewed. Five taxa have been sampled and training provided for veterinarians in the Dominican Republic, Grand Cayman, and Jamaica. Extended funding is being sought to continue testing in perpetuity. (3) Updated IUCN Red List assessments are continuing. (4) Chuck Knapp and Rachel

Participants in the 2003 IUCN/SSC Iguana Specialist Group Meeting in the Turks & Caicos Islands. TOP: Rick Hudson, Sandra Buckner, Fred Burton, Quentin Bloxam, John Iverson, Catherine Malone, Jan Ramer, Allison Alberts, Bonnie Raphael, Miguel Garcia, Karen Graham. MIDDLE: John Bendon, Chuck Knapp, Peter Harlow, Victor Reynoso, Rick Van Veen, Joe Burgess. BOTTOM: Glenn Gerber, Lee Pagni.

Glenn Gerber and workshop facilitator Fred Burton discuss options for controlling the movement of cats between Water and Little Water Cay. *Photograph by Rick Hudson.*

ISG field trip to Little Water Cay, a popular tourist destination for viewing iguanas in the Turks & Caicos Islands. *Photograph by Rick Hudson.*

A male *Cyclura c. carinata* habituated to human activity looking for handouts near the tourist boardwalk on Little Water Cay. *Photograph by Rick Hudson.*

This boardwalk on Little Water Cay (LWC) provides access for tourists to experience iguanas in their native habitat and is the primary source of income for the TCI National Parks Trust. Unfortunately, cats have reached this tiny island and are beginning to affect the iguana population. *Photograph by Rick Hudson.*

Goodman are submitting reports on transmitter attachments to *Herpetological Review*. (5) For the purpose of assessing progress on the SSC Strategic Plan, a report of ISG contributions is being prepared for the IUCN. (6) The International Iguana Foundation (IIF) is resubmitting its proposal to the National Fish and Wildlife Foundation (NFWF) for a Navassa habitat assessment grant. IIF grants for 2003 included support for work in St. Lucia, Anegada, Jamaica, Grand Cayman, and the Dominican Republic. (7) The newly developed ISG mission statement reads: *The Iguana Specialist Group prioritizes and facilitates conservation, science, and awareness programs that help ensure the survival of wild iguanas and their habitats.*

Management Plan Workshop

Quentin Bloxam and Fred Burton facilitated the development of a Conservation and Management Plan (CMP) for *Cyclura carinata carinata*. Ethlyn Gibbs-Williams, head of the TCI National Trust, introduced discussion and the following goal was established:

Conserve and restore populations and the geographic distribution of the Turks and Caicos Rock Iguana, and perpetuate it as a symbol of national pride and sound environmental management..

Some of the steps necessary to achieve this goal: (1) maximize genetic diversity, (2) control exotics (dogs, cats, rats, cattle, goats, donkeys, plants), (3) enact formal legislation to protect iguanas, (4) establish a system of protected areas, (5) control tourist-related development and tourist access to critical habitats, (6) achieve protection for additional habitats, (7) continue to monitor populations and translocations as necessary, (8) acquire better genetic data, (9) establish and maintain dialogue with developers, and (10) develop the necessary political will.

Future Meetings

In 2004, the ISG will meet in Fiji to develop species recovery plans for Fijian iguanas, *Brachylophus fasciatus* and *B. vitiensis*. Tentative plans for future years include Andros Island in 2005 and the Galápagos Islands in 2006.

2003 ISG Meeting—Providenciales, Turks & Caicos Islands

ABSTRACTS

Allen's Cays Iguanas, *Cyclura cychlura inornata*: Summary Report for 2003

Field work this year was confined to a single trip (14–21 May 2003), during which we captured 214 iguanas on Leaf Cay (95% of them recaptures!) and 102 on U Cay (93% recaptures). We have made 4543 captures over the 24 years of this study. Leaf Cay probably supports at least 600 iguanas, and U Cay perhaps 300. The pattern of most captures being made on the big west beach of Leaf Cay continued, with 58% being made there (154 of 350 or 44% last year). The profound attraction of the iguanas to the tourist feeding beach cannot be denied. A female U Cay iguana (marked there first in 1992, now 18.7 years old, and last observed nesting on 7 July 2002) was discovered on the streets of Nassau on 3 May 2003.

We also captured seven iguanas on Allen Cay (57% recaptures), including a large male originally marked on Leaf Cay in 1998, and last caught on Leaf Cay last May. We also had captured a marked male from Leaf Cay on Allen Cay last year. Excluding the two relocated males on Allen Cay, in the past three years we have captured a total of five females and six males there. The population may number between 15 and 20 based on our subjective walking censuses. In addition, a possible sighting of a juvenile suggests that, although upland sandy areas are absent, at least one female may have found a suitable nesting site. Barn Owl predation (and possible iguana predation) on shearwaters remains a concern.

We also briefly visited Flat Rock Reef Cay, north of Leaf Cay, and confirmed that at least 15 iguanas are present on this newly colonized island. Although extremely wary, we observed juveniles and captured three lizards, including a large male originally marked on Leaf Cay, and last captured there in March of 1996. Because of the distance and local currents, this animal was certainly moved there by humans.

Allen's Cays Iguana (*Cyclura cychlura inornata*). *Photograph by Lynne Pieper.*

Of ten large (>40 cm SVL) males captured last May on the big west beach of Leaf Cay, we captured only six this May. The disturbing, ongoing pattern of disappearing large males on Leaf Cay continues. We suspect that "tourists" may be relocating large, "aggressive," nuisance male iguanas from the primary tourist feeding beach on Leaf Cay to other cays.

Iguanas in the Allen's Cays clearly are being increasingly disturbed by humans through translocation, overfeeding, and likely poaching (for the food and/or pet trades). As we recommended in last year's report, a desperate need exists for the construction of an "iguana information kiosk" on both Leaf and U cays. Not only could this provide general natural history information to interested tourists, but it could also explain the dangers of harassing, improperly feeding, and relocating the iguanas, as well as the potential threats presented by feral animals.

We continue to implant PIT tags as time and money permit, and have now PIT-tagged a total of 506 lizards. We had three PIT tag failures this year (i.e., the tags were palpable under the skin, but transmitted no signal) and one in which we could detect no signal but also could not palpate the transponder. We also noted that a few PIT tags injected in previous years had migrated ventrally along the body wall from the site of injection. This mislead us in past years into thinking that the tag was missing/non-functional in a few individuals, when it was, in fact, still present. As a result, at least two iguanas now have two pit tags. In general, the failure rate of PIT tags is quite low, as is the failure rate of toe clips due to natural toe loss. The combination of the two methods is optimal for our study populations.

Although we had intended to spend mid-June to mid-July again this year in the Allen's Cays monitoring the iguana nesting season for a third year, family health issues prevented that. However, the results of our two-year nesting study are in press. We will return in May 2004 for another census, and we are planning long-term to repeat our nesting study in the summers of 2008–2010.

John B. Iverson

Department of Biology, Earlham College, Richmond, Indiana

The Blue Iguana, *Cyclura lewisi*, Recovery Programme, Grand Cayman: Summary of Progress for 2003

Detailed quarterly updates on the Blue Iguana Recovery Programme have been circulated by email to ISG members and the wider public, with back numbers available on request (email: fjburton@candw.ky). This document is a summary of the period from December 2002 to November 2003.

Protected habitat.—With the imminent release of approximately 25 subadult *C. lewisi* hatched in 2001 into the QE II Botanic Park, that 65-acre property would be supporting its maximum carrying capacity. This means subsequent releases should be directed at restocking or reintroducing animals into a new area.

Discussions have been held with the Cayman Islands Government, which in 2003 acquired a 295-acre land holding in East End Interior, within the recent historic range of *C. lewisi*. The land, which is a working farm with areas of uncultivated shrubland and some wetland forest, was purchased as an extension to the local prison's farm, and as the site of a future wilderness rehabilitation center for minor offenders and low risk long-term prisoners. The Ministry responsible for the prison service has reacted positively to the suggestion that the land could also serve as a site to support a second wild, managed population of Blue Iguanas, involving the prison inmates in associated conservation work.

Realization of this possibility will depend mainly on accessing the substantial funds that will be needed to effectively protect this site from roaming dogs and feral cats, both of which are abundant in this area. An extensive predator exclusion fence will be required, followed by an intensive cat and dog eradication effort.

Programme staffing.—Funds from IIF and a local corporate source allowed the program to hire its only paid staff member, Ms. Desiree Ebanks, in January 2003. Ms. Ebanks has been working 4 h/day, 6 days/week caring for the rapidly expanding captive population. As a result, for the first time in many years, we are able to feed the captives a diet dominated by wild food, collected daily from sites around the island.

With the dramatic increase in the captive population in 2003, Ms. Ebanks' working hours must be increased, with corresponding demands on project funding. F. Burton has continued to direct the programme on a full-time voluntary basis throughout the year. Craig Pelke, area supervisor at the Milwaukee County Zoo, visited Grand Cayman for two weeks under a funding scheme from his zoo to assist in the field with the Blue Iguana Recovery Program.

Grand Cayman Blue Iguana (*Cyclura lewisi*). *Photograph by Fred Burton.*

Overseas, voluntary and professional support has continued to flow from many individuals in the ISG and IIF networks.

Volunteer assistance has surged, ranging from weekend work parties painting new breeding pens through service club assistance to major corporate participation. Prison labor also has been used extensively.

Captive breeding and head-starting.—A total of 86 *C. lewisi* were successfully hatched from incubated eggs on Grand Cayman in 2003. Of these, 32 are captive-bred; the remainder was hatched from eggs laid by the released, managed population living in the QE II Botanic Park. The latter were collected for head-starting. Survival is almost 100%.

The resurgence in captive breeding success was attributed to improved diet (see above) and improved space. Two new founders bred well, providing important genetic stock, some of which is destined for breeding loans to US facilities. The large boost in numbers from QEIIBP wild nests reflects increased nesting surveillance, and the increased output from the Park's growing females. The age profile of the released population is still very young (max. 8 years old), so the output from this population is expected to continue to climb.

The breeding facilities expanded by four large breeding pens (36 x 48 ft), into which the large adult breeders were moved (one pair per pen) in March. The iguanas' physical condition improved visibly after the move and pairs that did not breed last year, resumed breeding. However, two key males (Hal and Billy) remained infertile, the former only beginning to recover from severe chronic malnutrition during a period of illegal captivity, the latter possibly lacking the stimulation of seeing other males during the breeding season.

A second phase of expansion of the breeding facilities commenced in July, with construction of more hatchling cages, site preparation for small adult breeding and holding pens, and a contained area for hatchling and second year cages. When this work is complete, the facility will be able to manage 100 new hatchlings per year (which will be head-started for two years before release) and sufficient adult holding space for current and projected needs.

Two new potential founders were captured from the wild in 2003, both young animals (one hatched in 2002 and one in 2003) were found in situations where continued survival in the wild was unlikely.

Stephanie James (Wildlife Conservation Society) visited during the year to health-screen animals destined for release as well as selected adults. Preliminary results confirm that the releases are safe to go, and the health of the captive population is generally excellent.

Education and awareness.—"Blue Dragon," a joint programme of the National Trust for the Cayman Islands and the Cayman Islands National Gallery, has been active throughout the year. This is an art-based project designed to attract interest from the entire local community. Sixteen giant fiberglass sculptures of the Blue Iguana were commissioned from a studio in the USA, delivered unpainted, and offered to selected local artists as a medium for expressive art. A wide range of interpretations is appearing, varying from realism to the abstract. Each iguana, once painted, will be permanently placed in a public area, with a sign providing core facts about the Blue Iguana and information about the artists and their inspiration. The project also involves school

activities and a new "Blue Dragon" poster designed for young teenagers. The sculptures are expected to last at least 10–20 years.

Building on the surge of awareness about the Blue Iguana, a longer-term approach is also underway. An education module for the local National Schools Curriculum, centered on the Blue Iguana, is under development. Local education specialist, Juliet Austin, is under contract to deliver modules through 2003–4.

A short film, designed mainly for school use in association with the curriculum modules, was filmed gratis by Dorothea Schwab (Wild Wings Vision, Cologne, Germany). Postproduction awaits funding for studio rental, professional editing, and sound work.

The programme has remained high profile in local news media, and a quarterly email newsletter "Blue Iguana Tales" has been launched. The project web site (www.BlueIguana.ky) continues to see incremental enhancements, thanks in large part to John and Sandy Binns.

Funding.—The phase 1 expansion of the captive breeding facility was paid for with grants from the Disney Wildlife Conservation Fund, Maples Finance (Cayman), Tulsa Zoo, Woodland Park Zoo, IRCF, and IIS, with assistance from Fort Worth Zoo.

A grant from IIF has been directed to generating sustainable financing, with retail products and a sponsorship program. Sale of mouse pads (designed and produced in collaboration with John and Sandy Binns) has yielded approx. $5,000 to date, and a "sponsor an iguana" programme was launched in October.

Funds from the Disney Wildlife Conservation Fund are covering the school curriculum work in part. A grant also has been secured from AZA/Conservation Endowment Fund to pay for materials needed in the phase 2 expansion of the captive breeding facility. A small grant from the St. Louis Herpetological Society is paying for creation of nest mounds for the released iguanas in the QEIIBP.

Research.—Work on the taxonomic status of the Blue Iguana has progressed: Fred Burton, assisted by Karen Graham and Trey Harrison, photographed reference specimens at the University of Kansas Natural History Museum for scale analysis, and additional images were provided by the San Diego Zoo. Fred has since submitted a paper, "Taxonomic status of the Grand Cayman Blue Iguana," to the Caribbean Journal of Science, which is now accepted subject to final revisions. The paper elevates the Blue Iguana to full species status, as *Cyclura lewisi*.

Rachel Goodman, University of Tennessee, is currently writing the results of her fieldwork on Grand Cayman, and will be publishing a series of papers on the released *C. lewisi* population in the QEIIBP. An additional paper (Burton, Goodman, & Gould), covering the diet of wild *C. lewisi* in various environments, is in preparation.

Institutional.—The National Trust for the Cayman Islands and the Durrell Wildlife Conservation Trust recently signed a memorandum of understanding that formally involves DWCT in the Blue Iguana Recovery Programme. This is a general framework agreement, with details of joint project activities yet to be determined.

The programme continues to operate under the auspices of the National Trust for the Cayman Islands, with a wide range of local and international partners.

Frederic J. Burton, Director

Blue Iguana Recovery Programme, Grand Cayman

Jamaican Iguana Field Research and Recovery Project: 2003 Summary

Forest Use.—Charcoal burning along the trail used by the iguana field team has greatly diminished. However, burners are encroaching deep into the forest along other trails. Also, harvesting of sticks in coastal areas remains a problem and has created a security risk for conservation activities in the south.

Nesting Season.—A total of 12 females showing indications of nesting were observed at the known nesting sites. Excavation and closing of the nest was confirmed in seven females. Nesting activities lasted from 1–20 June, and peaked 8–11 June. Eight of the 12 females could be individually identified by PIT tags and/or beads. Two of these females were repatriated headstarters, including one that was observed nesting for the first time. From 2000–2003, a total of 15 tagged females nested at the known sites; six of these females were repatriated headstarters. Blood of five animals (four nesting females and a male) was collected during the nesting season for analysis.

Hatching.—Hatchlings emerged from 25 August to 14 September and were intercepted by fences around the nesting sites. Nine batches of hatchlings could be distinguished, probably representing different clutches. Overall, 71 hatchlings were recorded, of which 68 (sex ratio 31:37) were equipped with PIT tags; 24 hatchlings were taken to the Hope Zoo.

Repatriations.—Nine headstarted animals were repatriated on 28 September, increasing the total number of repatriations to 57. An additional 8–9 iguanas will be released later in the year. Maximum confirmed period of survival in the field after repatriation was extended by 1–2 years for four previously released iguanas.

Predator Control.—The system of 40 live traps continued to operate and produced similar results as in previous years, capturing mongooses, cats, and rats. Experiments using "artificial nests" (chicken eggs) to assess the effectiveness of the predator control measures were expanded.

Pitfall trap survey.—The annual pitfall trap survey was conducted from 23 January to 22 April. It monitors possible positive population responses of rare species, particularly among the ground-dwelling herpetofauna, to the reduced density of mongooses.

Portland Bight Protected Area (PBPA).—Jamaica's conservation authority (NEPA) has assigned major management responsibilities to an environmental NGO (CCAM) for parts of the PBPA — but excluding the Hellshire Hills and Goat Islands. Although CCAM has some non-management functions for

Jamaican Iguana (*Cyclura collei*). *Photograph by John Binns.*

these latter areas as well, actual management will be up to the landowner, the Urban Development Company (UDC). It remains to be seen how UDC and CCAM will split responsibilities for the areas that are most important to the iguanas. Cooperation between the two organizations has failed so far. Work on the establishment of a satellite population of iguanas on Great Goat Island will have to await the clarification of these management issues.

Peter Vogel
Department of Life Sciences, University of the West Indies, Kingston, Jamaica

Territorial and Reproductive Behavior of the Mona Rock Iguana, *Cyclura cornuta stejnegeri*

In March 2003, the University of Puerto Rico (UPR), in collaboration with the Department of Natural and Environmental Resources (DNER), initiated a three-year project on the Mona Island Iguana, *Cyclura cornuta stejnegeri*. Our final goal is to gather information about the biology of the Mona Island Iguana to create a model establishing the actual status of the population, and to provide the conceptual framework for conservation efforts of this species. Specifically we want: (1) to understand the pattern of habitat use and territoriality, (2) to determine the mating system and variance in reproductive success, and (3) to quantify the survival and recruitment of young iguanas into the adult breeding population.

We are using radio telemetry of males, females, and immature individuals, mark-recapture, geographical information systems, and paternity analysis. To date, we have captured 40 animals of all sizes that were measured, photographed, and marked (i.e., pit-tags, colored beads, dorsal scale removal). Tissue samples also were taken from each iguana.

Five marked animals were headstarted iguanas that were released into the wild more than a year ago. In addition, fourteen of the captured iguanas have been radio-marked, producing information about home range and habitat use before, during, and after the nesting season.

During the hatching season, we collected and processed the offspring of ten radio-marked females for paternity analyses. Some of these hatchlings are kept in captivity in the headstarting facilities and others were released into the wild.

Mona Island Iguana (*Cyclura cornuta stejnegeri*). *Photograph by Robert Powell.*

For the next year, we plan to include two new areas for documenting habitat use and territoriality of radio-marked iguanas in different environmental conditions (e.g., vegetation structure, availability of crevices) through seasons. In addition, we plan to start radio-marking mid-sized iguanas and conduct extensive capture-recapture sessions in the selected areas.

Nestor Pérez and Owen McMillan
University of Puerto Rico, Río Piedras
Alberto O. Alvarez and Miguel A. Garcia
Puerto Rico Department of Natural and Environmental Resources, San Juan

2003 Research Update for Exuma (*Cyclura cychlura figginsi*) and Andros (*C. c. cychlura*) Islands, Bahamas

Research in the Exuma Islands, Bahamas focused primarily on surveying the translocated iguana (*Cyclura cychlura figginsi*) population on Pasture Cay in the Exuma Cays Land and Sea Park and the natural populations on Bitter Guana and Gaulin Cays.

In February 1992, 16 Exuma Island iguanas were translocated from Leaf Cay (NW of Lee Stocking Island) to Pasture Cay, Exuma Cays Land and Sea Park. During the 2003 field season, our primary objective was to initiate a live-trap rat study, check the status of the translocated iguanas, and search for evidence of first year iguana recruitment.

A total of 137 trap nights was recorded on 26–27 May. Eleven rats (including one recapture) were registered, marked by toe clipping, and released. Thirteen iguanas were captured, including one first-year hatchling. The recaptured adult iguanas all appeared healthy. Finding a healthy first-year hatchling was encouraging, and supports my supposition that rats do not pose a significant threat to iguana populations. More data obviously are needed to substantiate this hypothesis and the study will be expanded in future years.

Unfortunately, two large male iguanas died after translocation. On 24 December 2003, iguana #11 was discovered washed up on a Compass Cay beach. The carcass was recovered by volunteers from the Exuma Cays Land and Sea Park and turned over to me. The other iguana (#12) was last seen by Park volunteers in March 2003 and discovered dead on 25 April 2003. The carcass was left on the main southwest beach, but was not recovered by my team.

Objectives for the 2003 Andros field season included: (1) estimating population density, (2) determining home range and habitat preferences for adults, (3) investigating reproductive ecology, (4) determining dispersal distances, habitat preference, and survival of hatchlings, (5) performing ethnographic interviews with local Bahamians concerning historic and contemporary iguana exploitation, and (6) distributing tourist surveys relating to perceptions of iguanas and willingness to pay national park entrance fees. Lack of space precludes covering all objectives here so the focus of this report will be reproductive ecology and hatchling survival.

Exuma Islands Iguana (*Cyclura cychlura figginsi*). *Photograph by John Binns.*

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

The reproductive ecology portion of the research was extremely successful. The Andros Iguana is the only iguana documented to nest in termite mounds, but I had only mild success finding nests in 2001 (N = 1) and 2002 (N = 3). However, 18 nests were discovered in 2003. Clutch size ranged from 3–19 eggs and SVL of ovipositing females ranged from 34.0–44.6 cm. A number of termite mound parameters (height and circumference, % vegetation cover, distance to < 50% canopy coverage, and average skirt depth) were recorded for used and unused mounds. Significant differences were evident only in mound height and average skirt depth. Temperature data loggers also were placed in and above five used mounds to record internal nest and surrounding ambient temperatures. Temperatures inside mounds were significantly higher and more constant than in the ambient environment.

Radio transmitters were attached to 41 hatchlings from seven nests in five locations and they were subsequently tracked for up to eight weeks. Hatchlings remained alive for an average of eight days, and only two hatchlings remained alive at the end of the study. One hatchling was presumed taken by a bird, another by a fish, and the remainder by snakes. We will return in 2004 to track additional hatchlings, but these results suggest that snake predation is significant on Andros and possibly throughout the West Indies.

Charles Knapp
Conservation Department, John G. Shedd Aquarium, Chicago, Illinois and Department of Wildlife Ecology and Conservation, University of Florida, Gainesville

Anegada Iguana, *Cyclura pinguis*: 2003 Update on Field Research and Release Project

In July 2003, the remaining wild population of *C. pinguis* was surveyed by an eight-member team of volunteers. Due to time constraints, the survey was confined to the western half of the island, which is believed to support the majority of the existing population. Over 50 km of line transects were walked, during which all sightings of animals, retreats, tracks, and feces were recorded. Nearly all of the sightings were confined to the known core iguana area on the northwestern coast of the island, and the boundaries of this area were more precisely delineated than ever before. All iguana sightings were of adult animals, indicating that the population's age structure is still heavily skewed. Iguana sightings were very few, making reliable estimates of population density or size difficult (but in progress). Nevertheless, based on previous fieldwork, the population apparently has declined further in recent years.

In an effort to offset this decline, 24 headstarted iguanas, believed to be large enough to survive in the wild with cats, were released in early October. This event was the first release to take place since the headstart project began in 1997. In April 2003, veterinary staff from the Fort Worth Zoo conducted a thorough health screening of all the potential candidates for release. The veterinary staff returned to surgically implant temperature-sensitive radio transmitters in the animals selected for release during the last week of September. Released iguanas had an even sex ratio and were equally divided between two size classes, averaging 1,005 g and 1,345 g, respectively (total range: 800–2000 g).

Twelve of the animals (six from each size class and sex) were released in the sandy scrub of eastern Bones Bight, whereas the other twelve were released in the interior rocky woodland of Middle Cay. Both release sites are within the core area and contain some of the best habitat remaining on Anegada. Animal locations were recorded daily by direct observation for the first 24 days after the initial release.

During this period, focal-animal observations on several individuals each day examined the behavior of the iguanas, with particular attention to foraging and intraspecific interactions. In addition, a remote data-logging telemetry station was used to continuously record body temperatures of the released animals to determine thermoregulatory patterns. To date, one loss has been experienced. The animal was found dead shortly after release; its surgical incision had reopened. All other animals are doing well. Additional monitoring of the released animals will take place during fieldtrips in November/December, January, March, May, and July. The released animals will be captured periodically to assess growth and general health.

Glenn Gerber
Zoological Society of San Diego CRES, San Diego, California
Kelly Bradley
Department of Herpetology, Dallas Zoo, Dallas, Texas

Public attitudes and perceptions regarding conservation of the Anegada Iguana, *Cyclura pinguis*: The use and role of social surveys in conservation

The public can have a major influence on the success of conservation programs, therefore, understanding and adequately addressing any concerns they might have is important. Understanding public attitudes and perceptions about conservation strategies is an important first step toward this end.

In an effort to develop educational programs that will increase public support for strategies to conserve the Anegada Iguana (*Cyclura pinguis*), I carried out a survey of local attitudes and perceptions in July 2003. I interviewed 36 residents of Anegada, British Virgin Islands (representing approximately 30% of the population) using a semi-structured format. Respondents were asked whether they supported or did not support four different conservation strategies: headstarting, cat eradication, national park implementation, and translocation. Respondents also were asked questions to assess their awareness regarding threats to and conservation strategies for the iguanas.

Lee Pagni interviews an Anegadian about attitudes regarding iguana conservation. *Photograph by Clinton "Lee" Vanterpool.*

The respondents highly supported three conservation measures: headstarting, cat eradication, and national park implementation. They were less supportive of translocation. In terms of awareness, respondents were generally aware of the threat that cats pose to the iguanas and the role that the headstart facility plays in counteracting this threat.

This information is extremely useful for the implementation of conservation strategies. The non-structured interview format was essential for obtaining other information about the community: perceptions, questions, and concerns that are additionally important. Collecting information on public attitudes raises the question of when and how public input should be used to guide management decisions.

Lee E. Pagni

Conservation Education Consultant for the Zoological Society of San Diego

Ricord's Iguana, *Cyclura ricordii*: Isla Cabritos Population Census 2003

In 2003, three teams of people from the Indianapolis Zoo, ZooDom, and the Fort Worth Zoo conducted iguana population surveys on Isla Cabritos, Dominican Republic. The work was funded primarily by the Indianapolis Zoo, with support from ZooDom, the Miami Metro Zoo, and the Cleveland Metroparks Zoo. On the first trip in April (which corresponded loosely with the breeding season), we used GPS units to set 20 transects that ran the width of the island every 500 m to the east of the main trail. We also collected our first set of data, recording all iguana sightings (Ricord's and *Cyclura cornuta*), as well as iguana sign such as dens, scat, etc. We also recorded sightings of cats, donkeys, horses, and cows. The island currently is connected to the mainland with a wide land bridge, and hoofed stock is much more numerous, especially on the west end of the island. We were pleased to find Ricord's Iguanas in fairly good numbers at several sites. In fact, they seemed to be more numerous than *C. cornuta* in the center of the island. In June, which we hoped would correspond with the nesting season, another group set four more transects, and walked each of the 24 collecting data. Several nests were marked during this trip, but the rangers believed that the animals had nested early this year due to early rains. In September, the last group walked all of the transects, and observed hatchling Ricord's Iguanas in two areas. The data are in the process of being formally analyzed and a more detailed report will follow. Many thanks to all the teams who suffered heat exhaustion, dehydration, scorpions in tents, geckos in the outhouse, and pony stampedes at night to collect these data!

Ricord's Iguana (*Cyclura ricordii*). *Photograph by Robert Powell.*

Other *Cyclura ricordii* news:

- Four hatchlings at ZooDom are doing well. You might remember that seven hatched during the ISG meeting last year; two died right away and one was accidentally crushed in the exhibit. Animal information has been passed to Tandora Grant for the studbook. No eggs were laid this year. 1.3 animals are currently on exhibit.

- Grupo Jaragua and the Indianapolis Zoo submitted a grant proposal to the Pittsburgh Zoo to support a socioeconomic study of why people are hunting iguanas in the Pedernales area. This is based on the preliminary survey work done by Ernst Rupp in this area.
- Indianapolis Zoo, ZooDom, and Grupo Jaragua submitted a major grant proposal to the U.S. Fish & Wildlife Service to support teacher and community education programs in Santo Domingo and towns bordering iguana habitat.
- A meeting date in 2004 needs to be set to discuss survey findings and determine next steps for a recovery plan based on these data.

Jan Ramer, DVM
Indianapolis Zoo, Indianapolis, Indiana

The Technical Consulting Subcommittee for the Conservation, Management, and Sustained Exploitation of Iguanas in México

The Technical Consulting Subcommittee for the Conservation, Management, and Sustained Exploitation of Iguanas in México (STC-Iguanas) is part of the National Program for the Recovery of Priority Species, which was created to promote working groups to develop conservation programs for selected species in México. So far, it joins 23 subcommittees, among which the marine turtle and crocodile working groups have been active for a long time. STC-Iguanas was constituted on 16 May 2002 in Villahermosa, Tabasco, as the result of five National Workshops on Captive Management of Iguanas.

The Subcommittee now has 46 active members, including researchers in biology, ecology, veterinary medicine, and electronics, as well as private and communal producers of meat and pets, and a governmental counterpart. It is divided into six regional working groups (North Pacific, West, South Pacific, Center, Gulf, and Yucatan Peninsula) and four by specialty (research, education, diffusion, and training; exploitation, inspection, survey, and legislation; and finance).

San Pedro Nolasco Spiny-tailed Iguana (*Ctenosaura nolascensis*). *Photograph by John Binns.*

Our main objective is to function as consultants for any activity related to the conservation and production of iguanas, to produce a document to regulate the protection and use of iguanas within UMAs (Management Units of Wildlife), the unique legal entity that regulates wildlife species for trade. Also, we promote discussion on problematic issues related to the conservation and management of these species among our members and create environmental education programs directed to rural communities associated with conservation and production programs.

Current activities include: (1) the organization of the VI National Workshop on Iguanas, including a full course on captive management; (2) the production of the first draft of the National Program for the Protection, Conservation, Research, and Management of Mexican Iguanas; (3) creation of a web site that will be linked to main pages addressing the conservation of iguanas; (4) creation of a literature data base about Mexican iguanas; and (5) promotion of a handbook for the captive management of iguanas.

The long-term goal of the STC-Iguanas is to generate management and conservation strategies for all species of iguanines. However, at this moment, we are focused primarily on what appear to be the most threatened species: the Green Iguana (*Iguana iguana*), the Black Iguana (*Ctenosaura pectinata*), the Tilcampo (*Ctenosaura acanthura*), and the Banded Iguana (*Ctenosaura similis*). Action has focused on providing alternative exploitation techniques to poor rural communities in Mexico in order to stop the massive hunting of these species, and to diversify iguana usage to increase people's income. Captive management has been considered one of the best options to combine traditional use of the resource with conservation; however, sustained exploitation of wild populations is now being explored.

Víctor Hugo Reynoso
STC-Iguanas, México; Instituto de Biología, UNAM, México, D.F.

The Pacific Banded Iguana: What We Know About Its Conservation Status

Although the Banded Iguana (*Brachylophus fasciatus*) is the more familiar of the two species of *Brachylophus* found in the South Pacific, its status in the wild is virtually unknown. Based on published and verbal distribution records, the species is known to occur on 34 islands in Fiji. In addition, it is found on four islands in Tonga and an introduced population is established on Efate Island in Vanuatu.

Today, Banded Iguanas have been virtually extirpated on the large Fijian islands where mongooses have been introduced, but they still are occasionally encountered on many other islands. Regular reports of Banded Iguana sightings from large and heavily forested islands like Kadavu and Ovalau still occur, as well as from some small, inhabited islands where cats are common and forest remnants are few. A boy with a pet Banded Iguana can be found in many villages, and Fijians still occasionally find them on forest paths, when they are clearing bush for new gardens, or when high in an Ivi or Bau tree picking ripe, edible fruit.

Fijian Banded Iguana (*Brachylophus fasciatus*). *Photograph by John Kinkaid.*

In September 2002, National Trust Crested Iguana Sanctuary ranger, Pita Biciloa, and I traveled to the large inhabited island of Lakeba, 300 km east of Fiji's capital, Suva. Our aim was to undertake the first systematic survey for Banded Iguanas. We had been told that Banded Iguanas were common on both of the Aiwa islands: Aiwa Levu and Aiwa Lailai. These are small, uninhabited limestone islands (total size: 121 ha), separated by 50 m of deep water, that lie about 12 km southeast of Lakeba. Both Aiwa Islands have been heavily grazed by goats for three or four decades and, although the tall forest appeared mature and diverse, the forest floor was completely open with only an occasional sign of undergrowth or forest regeneration. In three nights on Aiwa Lailai, we counted over 200 Banded Iguanas along our 2 km of transect lines.

Although these lizards are not as abundant as Crested Iguanas are in optimal forest habitat on the Crested Iguana Sanctuary island of Yadua Taba, Aiwa Lailai appears to support a very healthy population of Banded Iguanas. If Aiwa Levu has a similar number of Banded Iguanas per hectare (which seems possible, based on the similarity in vegetation and goat grazing pressure), then these two small islands may have a total population of 6000–8000 iguanas. Small, remote, and virtually inaccessible islands are abundant around Fiji. Their remoteness may be their greatest asset, and hopefully will continue to keep feral animals, invasive plants, and destructive agricultural practices away.

Peter S. Harlow
Herpetofauna Division, Taronga Zoo, Mosman, NSW, Australia

The Fijian Crested Iguana: Lost in the South Pacific?

Described in 1981, the Fijian Crested Iguana (*Brachylophus vitiensis*) has been recorded on fewer than ten dry, rain-shadow islands in western Fiji. Using line transect surveys, we estimated the iguana population on the small Crested Iguana Sanctuary island of Yadua Taba (70 ha) at almost 200/ha in beach forest habitat; an average of one iguana per 5 m of transect and an estimated total population for this small islands of more than 6000. Additional surveys of 12 uninhabited and five inhabited islands in the Yasawa and Mamanuca island groups in western Fiji in September 2000 revealed very different results. All of these islands have free-ranging goats and forest fires have occurred repeatedly on most of them over the last few decades. Iguana survey transects were purposely placed through areas within beach forest remnants that had the maximum number and diversity of iguana food tree species. Night searches for sleeping iguanas along a total of 11.2 km of beach forest transects were thus biased towards maximizing our chances of locating this species, and were not designed to estimate average abundance. Groups of 2–5 team members intensively searched the forest along each transect, and collectively searched a total of 44 km over 123 h.

Results suggest that Crested Iguanas are extremely rare or extinct on all of these islands. We found iguanas on only four of 17 islands surveyed: three small, uninhabited islands and a single large inhabited island. A total of six live iguanas were seen on these four islands, plus one dead juvenile iguana was found. It had been killed and partly eaten, presumably by a cat. Feral cats occur on all inhabited islands, were seen on one uninhabited island, and probably exist on most of the other uninhabited islands we surveyed. On all of these islands, Crested Iguana abundance in optimal forest habitat was < 1 iguana per hectare. As Crested Iguanas are not hunted, eaten, or traded, their rarity on all islands except Yadua Taba appears to be due to the combination of habitat loss and degradation due to forest clearing, burning, and intensive goat grazing, and the introduction of invasive plant species and exotic predators such as cats and rodents.

Peter S. Harlow
Herpetofauna Division, Taronga Zoo, Mosman, NSW, Australia

Fijian Crested Iguana (*Brachylophus vitiensis*). *Photograph by Peter Harlow.*

Turks and Caicos Iguana, *Cyclura carinata carinata*: 2003 Project Update

In January 2003, we conducted our last planned translocation of iguanas in the Turks and Caicos. Sixty adult iguanas (30 males, 30 females) were moved from Big Ambergris Cay to Six Hills Cay East, a 4-ha island located approximately 10 km north of Big Ambergris. With this move, we have founded a total of four new populations and moved 218 adult animals: 76 from Little Water Cay, threatened by feral cats, to Middle Cay (n = 18) and Bay Cay (n = 58) in the Five Cays, and 142 from Big Ambergris Cay, threatened by development, to French Cay (n = 82) and Six Hills Cay East (n = 60).

To assess the success of these new populations, we have been comparing their biology (survival, growth, reproduction, diet, and endocrinology) to that of their respective source populations. With the help of over 20 volunteers, fieldtrips were made to all of the translocated and source populations in January/February, May/June, and August/September 2003.

On each of the translocation cays, we found evidence of nesting in May/June, and captured and marked newly emerged hatchlings in August/September. Although we have found no difference in hatchling size between translocated and source populations, yearlings on the translocation cays are averaging 2–4 times the mass of those on the source cays. Translocated adults also are experiencing increased growth rates relative to adults on the source cays, although the difference is not as great. We attribute increased growth rates on the translocation cays to the relative lack of competition for food and space on these islands, and predict that growth rates will decrease as these populations begin to approach carrying capacity. Survival of the translocated adults and their progeny appears to be very high. To date, only four of 218 iguanas translocated are known to have died, corresponding to a survival rate of 98% among adults.

Glenn Gerber and Allison Alberts
Zoological Society of San Diego CRES, San Diego, California

Turks and Caicos Iguana (*Cyclura carinata carinata*). *Photograph by John Binns.*

Lesser Antillean Iguanas, *Iguana delicatissima* and *I. iguana*

A preliminary visit to St. Eustatius in September 2003 suggested that the population there is in much worse condition than anticipated. In light of threats elsewhere, the "threatened" Redlist status may no longer be warranted. Bob Powell will be doing some more extensive work on St. Eustatius in June 2004, tying to establish the extent of the species' range on the island, estimate current numbers, and initiate a program leading to greater awareness of the iguanas' plight by Statians. Michel Breuil and Bob Powell will be revisiting the species' Redlist status, looking both at the entire species and island-by-island populations.

Lesser Antillean Iguana (*Iguana Delicatissima*). *Photograph by Glenn Gerber.*

The September issue of IGUANA included a newsbrief on Anguilla, in which Karim Hodge reported discovering evidence that Green Iguanas are breeding in an area near where they arrived a few years ago, but where they weren't supposed to be anymore. The potential threat to *I. delicatissima* is obvious.

During the summer of 2002 on Grenada, we encountered so few Green Iguanas (*Iguana iguana*) that we were unable to generate any meaningful data. Anecdotal information from residents suggests that the animals are common nowhere and are most likely to be encountered in dry forests near developed areas where no hunting occurs.

Apparently, hunting has considerably reduced populations of these lizards in moist upland forests, although some reasonably healthy populations may still occur in areas that remain very difficult to access. Note that, on Grenada, Green Iguanas are considered game animals and a hunting season exists. This obviously makes it easier for poachers to ply their trade, especially since enforcement of existing regulations is lax to non-existent.

Robert Powell
Department of Biology, Avila University, Kansas City, Missouri

St. Lucian Iguana Project: 2003 Summary

Activities for the year included eight principal areas: (1) Beach searches: Goals were to collect distributional data across St Lucia using the most efficient search method (nesting signs), prioritize search efforts (sites) for 2004, and identify methodological considerations for assessing habitat suitability. Almost all beaches around St Lucia were searched at least once, although this effort was insufficient, attributable primarily to earlier than anticipated onset of nesting and lack of manpower. (2) Nesting indices: The principal goal was to generate an index or indices of nesting female iguana numbers from counts of nesting signs (to be used for future monitoring). Some data for the main nesting beach will allow a preliminary examination of the feasibility of calibration (see 3, below); data for the only other known nesting area, are insufficient. Data are pending analysis, but are likely to be insufficient to generate a reliable index, attributable primarily, as in 1 above, to earlier than anticipated onset of nesting and lack of manpower. (3) Hatchling counts: The primary goal was to obtain a full count of hatchling numbers (and by extrapolation nesting female numbers), primarily to calibrate the easier-to-collect index of nesting (see 2, above). A reasonably full count was made (the onset of hatching was missed, but we can extrapolate back). Also, data on hatchling sex ratios, emergence times, body condition, and health problems were collected. The onset of hatching was earlier than anticipated (even taking into account the earlier than anticipated onset of nesting). I believe all major nests at the main nesting beach were monitored. We were not able to monitor the other nesting beach. (4) Hatchling predator counts: The principal goals were to quantify predator activity at the place and time of hatchling emergence and to confirm mongoose predation on hatchlings. I believe all the main predators at the nests are identified. Stomach contents confirm predation by mongooses. Cats were identified as a predator in 2003 (but not in 2002). Quantitative data were collected, but not rigorously. Standardized counts will require more manpower if attempted alongside hatchling counts (as in 2003). Greater trapping effort is warranted next year, including areas away from nest sites (5) Radiotracking females: The principal goal was to confirm a nesting migration distance of 2–3 km to the main nesting beach. To date, only one large adult female has been tagged in the zone 2–3 km from the beach, despite two months of effort. The tagged female initially behaved as expected, moving in a small home range, but in December began moving toward the nesting beach. Tracking and searches for more females to tag are continuing, led by the Forestry Department, with GPS location updates by email. (6) Site management (main nesting beach): The primary goal is to utilize an agreement with the landowner to alert local people to, and enforce if necessary, changes in site management at this beach. Four metal signs have been erected to advise locals to keep dogs leashed, road access to the nesting beach is blocked with chain (to hinder sand mining), weekly patrol routes have been mapped, and an agreement has been reached with the Forestry Department on patrols. The Forestry Department will continue to patrol weekly by van, at least through the vulnerable nesting period (roughly January–May). They will seek cooperation from the St. Lucia police for accompaniment by an armed officer to shoot untied dogs. Well-attended community-led beach clean up (post hatching) led to extensive media coverage. This effort was primarily educational in intent (rubbish leads to rats leads to mongooses). (7) Ecotourism initiative: The principal goal was to assess the potential for community-based, small-scale ecotourism within key communities currently using known iguana sites. A feasibility study, covering primarily an assessment of the natural resource base (conducted by the Forestry Department) and a stakeholder analysis (conducted by Heritage Tourism) is in preparation. This is essential for developing a funding proposal. Although Heritage Tourism has yet to conduct their stakeholder analysis workshop, I hope the funding proposal will be developed/submitted to seek funds for the financial year starting April 2004. (8) Education proposal: The principal goal is to develop a community-based program of curricular activities addressing iguana conservation in northeastern St. Lucia. A full proposal, with detailed activities, timeline, and budget, is to be submitted by the Forestry Department as the St. Lucia lead and (tentatively) by K. Graham (Sedgwick Co. Zoo) as the overseas contact.

St. Lucian Iguana (*Iguana iguana*). *Photograph by Matthew Morton.*

Matthew Morton

Durrell Wildlife Conservation Trust
c/o Forestry Department, Ministry of Agriculture, Castries., St. Lucia

HUSBANDRY

Spiny-tailed Iguanas: Captive Care[1]

Gunther Köhler[1], AJ Gutman[2], and John Binns[3]

[1]Forschungsinstitut Senckenberg, Frankfurt a/M, Germany;
[2]West Hartford, Connecticut, USA; [3]San Jose, California, USA

Acquisition and Acclimation

A number of factors must be considered before acquiring a Spiny-tailed Iguana (*Ctenosaura* spp.), the most important of which is making the long term commitment involved in caring for a lizard that can survive 20 years or more. Since the survival and health of the iguana is completely dependent on the quality of care provided by the owner, he or she must consider future changes in his or her own life and the necessary accommodations that must be made to properly maintain these animals. Some species grow very large (over 1 m in total length), although others remain small (less than 25 cm in total length). Potential owners must recognize that a hatchling of one of the larger species can grow to a meter in length within 2–3 years and will require very roomy quarters.

A qualified reptile veterinarian experienced in iguana care should be located to provide general health checks as well as emergency services, should those be required. Provision also must be made for an alternate caretaker should the owner be away or unable to provide care. Accurate records should be kept

[1] Adapted and expanded from Köhler, G. 2002. *Schwarzleguane. Lebensweise, Pflege, Zucht*. Herpeton Verlag Elke Köhler, Offenbach, Germany. Most changes reflect the different realities of European and North American ctenosaur husbandry. Different products necessary for proper care are available and, although several species are commonly kept in Europe, most Americans keep only *Ctenosaura similis*, a large and frequently aggressive form.

Ctenosaura nolascensis is long-lived and can become large. Prospective owners must give consideration to providing an enclosure of sufficient size and care for an extended period of time. *Photograph by John Binns.*

An outside view of an enclosure's UV-transmittable window and one happy iguana. A "room with a view" and sunlight does wonders for captive animals. *Photograph by John Binns.*

Terry-cloth towels are useful in handling less manageable animals by reducing the need to tightly clutch the animal. This reduces the stress of handling and the towel provides protection from the Spiny-tailed Iguana's sharp spines and barbed tail. *Photograph by John Binns.*

This simple display uses beach wood, artificial plants, fake cement stone, and corrugated tubing (hidden). The beach wood was arranged to provide multiple basking spots and careful stacking of parts ensured that they would not collapse. The feeding dish and water bowl are to the left of this photograph. *Photograph by John Binns.*

for each animal, including weights, measures, diet, and emergency telephone numbers.

Spiny-tailed Iguanas and Green Iguanas (*Iguana iguana*) differ in their captive care requirements. Ctenosaurs have a very different disposition than Green Iguanas, although this is a generalization and temperament will vary from one individual to another. One of the reasons for the popularity of Green Iguanas is their predominantly friendly and sociable nature; most animals will become quite tame over time with proper handling and care, and (with reasonable precautions) are easily handled, much like any "normal" house pet. In contrast, certain species of Spiny-Tailed Iguanas can be quite wild and difficult to manage. Tremendous patience and effort may be required in order to modify the behavior of such an animal. Some of the smaller species may be easier to work with, but only rare individuals will become sufficiently tame that they can be taken out of their enclosures. The chances for successfully taming an individual are much better when dealing with juveniles than with subadults or adults.

Spiny-tailed Iguanas produce relatively small, hard, dry fecal pellets, whereas Green Iguanas will excrete a far greater volume of solid waste, not to mention a considerable amount of fluid. For this reason, a Green Iguana habitat, out of necessity, must be easy to clean, and its aesthetic appeal can be no more than a secondary consideration. In contrast, an attractive natural environment can be created for a Spiny-tailed Iguana with less concern for hygienic problems or overpowering odors. Still, the enclosure should be designed to facilitate regular maintenance, especially when keeping larger Spiny-tailed Iguanas, which are prone to rearranging their cage furnishings. Changes in fecal consistency from a relatively dry to moist/runny deposits suggest a dietary imbalance or improper thermal gradient within the enclosure.

The time commitment for one male and one or two females will be a minimum of 30–60 minutes a day (food preparation, cleaning food and water dishes, and general maintenance). If problems arise (incompatibility or illness) or if the animals are breeding (egg laying, incubation, hatching), the time commitment increases accordingly, particularly if any of these situations require the setup and maintenance of extra enclosures.

These paired *Ctenosaura acanthura* often share the same basking spot and are rarely apart. *Photograph by John Binns.*

A number of ctenosaur species have been bred successfully in captivity, some with regularity and others less frequently. In any case, acquiring captive-bred animals is always preferable. Acquiring wild-caught animals only encourages the importation and exploitation of iguanas and limits the chances of the species' long-term survival in their natural habitats. Wild-caught animals are highly stressed, frightened, often ill (particularly due to heavy parasite loads), and their chances for survival are minimal. This is compounded by their fearful and flighty nature, resulting in a reluctance to eat and a host of other problems. Of those that do survive, all will remain wild and their life expectancy will be greatly shortened. Although captive-bred animals are not always parasite-free, they are considerably more stable, primarily due to having had fewer negative encounters with humans. Their behavior likely will be calmer and more trusting. Nevertheless, juveniles inevitably will acclimate more quickly than adults.

The territorial nature of Spiny-tailed Iguanas needs to be considered when deciding the number of animals to place in a single enclosure. Sex is not easily determined in very young ctenosaurs and, although a male and a female or a pair of young females are more likely to be compatible, and two males will definitely fight, no combination of numbers or sexes will assure that the animals will co-exist without some altercations. The size of the enclosure (generally "bigger is better") may be the deciding factor in providing sufficient territory for more than one animal. Introduction of animals into their new enclosure requires close observation to ensure compatibility. Dominance develops at a very young age, and can range from establishing a natural pecking order to violent biting and life-threatening aggression. A second enclosure must be available should the dominant animal create an unhealthy, irresolvable situation with its mate or other female animals in the enclosure.

On the positive side, competition for food may encourage others in the group to eat more than they would if they were held alone. A bolder and more curious individual may prompt others in the group to behave likewise, thus creating a healthy environment. Continuous monitoring of the behavior of either an individual or a group of animals is a key element of good husbandry.

Several tips may facilitate acclimation: (1) The habitat should be elevated so that the animals are at eye level with their caretakers. (2) Enclosures that open only at the top, such as refurbished aquaria, are ill-suited for iguanas. Many natural predators of young iguanas' (raptors!) attack from overhead, thus they instinctively fear anything coming from above. (3) The habitat should ultimately be set up in a high-traffic area as this helps to acclimate the animals to the presence of humans, making interaction with their caretakers less stressful. However, allowing 2–3 weeks after quarantine for the animals to first acclimate to their new habitat and/or new companions in order to reduce the high stress of translocation may be beneficial before they are moved to a more active area. Children should be cautioned not to handle or irritate the iguanas (e.g., by banging on the glass). (4) Owners should take time daily to tend to the animals while both animals and owner are calm and relaxed. Sit by the habitat and just observe them. The animals, in turn, will be able to observe their caretaker while at a safe distance. After a few days, when you feel that the iguanas have become somewhat accustomed to your presence, you can carefully slide open the enclosure and determine if further interaction is feasible. Some animals can be handfed without any difficulty, but others will be just as prone to attempt an escape or bite an intrusive finger.

Even if the new owner is experienced in iguana husbandry, newly acquired iguanas should be thoroughly examined by a qualified reptile veterinarian and quarantined until results of the examination are known and any required treatments have been successfully completed. This must precede any introduction into an enclosure with other animals. This examination typically entails a blood test, a fecal sample to determine if parasites are present, and a check for mites and ticks, injuries, swellings, and skin lesions. The results of the series of tests will determine the overall health of the animal and, should treatment for illness or parasites be required, the veterinarian will either suggest regular visits to administer the medication and treatment, or provide you with detailed instructions for treatment at home. Some types of parasites are fairly easy to eliminate, but for others, treatment can be expensive and lengthy, and the medications are not always well-tolerated by the animal. To determine if the parasite treatment was successful, the veterinarian must rerun the parasite test (fecal sampling). The veterinarian can provide guidance regarding the necessary quarantine period.

A small auxiliary enclosure that provides all the environmental needs for the animal is preferable for quarantine. Treatment often requires elevating the ambient temperature and humidity within the enclosure, and a smaller enclosure permits easier maintenance of a constant temperature and a larger water bowl can be used to increase humidity through evaporation in the heated environment. The use of an auxiliary enclosure also prevents internal and external parasites and bacteria from contaminating the main enclosure, and it is best constructed of a material that is easy to clean and disinfect. Disinfecting agents containing peroxide or alcohol should be used to clean habitats and equipment. Under no circumstances should products containing phenols or other toxic agents be used. The enclosure should be void of all non-essentials items, containing only food and water bowls and an absorbent material for waste management. Bowls should be washed with antibacterial soap and thoroughly rinsed

Sandblasted wood branches and some artificial plants keep a display from looking bare. This enclosure uses commercial plastic paneling that facilitates cleaning and adds a level of thermal insulation. All seams are sealed to minimize problems with ants and other insects. The window is UV-transmittable glass, providing a substantial amount of natural sunlight during the day. The vent at the top extracts air from the enclosure with a fan to help minimize odor and draw fresh air into the enclosure through vents at the bottom. An additional heat-lamp that was installed for the winter months is barely visible at the top of the window. *Photograph by John Binns.*

with fresh water after each use. Waste from the animal should be removed immediately and clean substrate provided.

Healthy Spiny-tailed Iguanas typically exhibit lively and inquisitive behaviors. During the active phase (daytime), the animals eat, threaten, court, or patrol their territory with alternating periods of basking or sleeping. Sick animals, on the other hand, will have sunken eyes and protruding pelvic bones due to loss of weight, and lack muscle on the legs and tail. They tend to lie apathetically at the bottom of the enclosure and do not react to their surroundings. Any movements tend to be halting and insecure and the lower abdomen often rests on the ground.

The importance of regular observation cannot be overemphasized. Behavioral changes could indicate illness or other problems for which treatment should be sought and administered immediately. Animals in the wild will instinctively conceal signs of illness to avoid attracting predators, reinforcing the need for careful observation.

Distinguishing the Sexes

In fully-grown males of most ctenosaur species, the dorsal crest is substantially more developed than in females. Exceptions are *C. alfredschmidti*, *C. clarki*, *C. defensor*, and *C. flavidorsalis*, in which neither males nor females have particularly well-developed dorsal crests. Adult males also usually have clearly visible hemipenial bulges under the base of the tail. Another important character for determining gender is the size of the femoral pores, which are always larger in males than in females. In adult male *C. similis*, the femoral pores can attain diameters of 2.5 mm, whereas they are rarely more than 1 mm in diameter in females.

Housing

The size of the enclosure will determine the degree of flexibility in design and setup. Planning must include provisions for animal barrier isolation and for developing lighting and temperature zoning for thermoregulation. In order to adequately provide for a complete behavioral repertoire, a ctenosaur enclosure must be large and sturdy. For an adult pair of any of the medium-sized or large species (subgenera *Ctenosaura* and *Loganiosaura*; see Köhler et al., *IGUANA* 10(3):79–81), a habitat should be at least 200 x 150 x 130 cm. For the smaller species (subgenus *Enyaliosaurus*), the minimum size would be 80 x 60 x 90 cm. As is the case with all medium-sized to large iguanas, space planning for adult sized animals is critical when initially considering the enclosure design. If the animals have been previously paired and are able to comfortably co-exist, the recommended enclosure size should be sufficient. However, if a male and female are purchased individually and are subadults or older, a second enclosure should be available in cases of incompatibility.

Hatchling Spiny-tailed Iguanas are best housed in groups of three or four in at least a medium-sized terrarium about 60 x 40 x 60 cm in size. Certain juveniles in captivity, like their counterparts in the wild, can be distinct loners and may be incompatible with other individuals. A well-structured terrarium with multiple basking spots and hiding places is required for raising juveniles together. Sometimes, however, despite all these measures, combatants must be separated to avoid injuries.

Setup

Because Spiny-tailed Iguanas are territorial, the habitat should be structured to permit animals to avoid one another, particularly if individuals vary in size. Visual barriers and hiding places can be created using rocks, tree roots, corrugated-drain tubing, cork tubes, or whole pieces of cork bark attached to walls. All structures and components need to be sufficiently secured and stable to prevent damage to the component or injury to the iguanas.

Isolation barriers may necessitate the provision of individual basking areas, and this should be considered when developing the enclosure design. Basking locations should be designed to incorporate a declining temperature zone for proper thermoregulation. This entails creating a surface that allows the animal to adjust its position relative to the central "hotspot" (high temperature areas) in order to maintain the correct body tem-

This female *Ctenosaura acanthura* will climb on her log to bask under UV lamps and comfortably wedge herself inside it to sleep at night. *Photograph by Carole Saucier.*

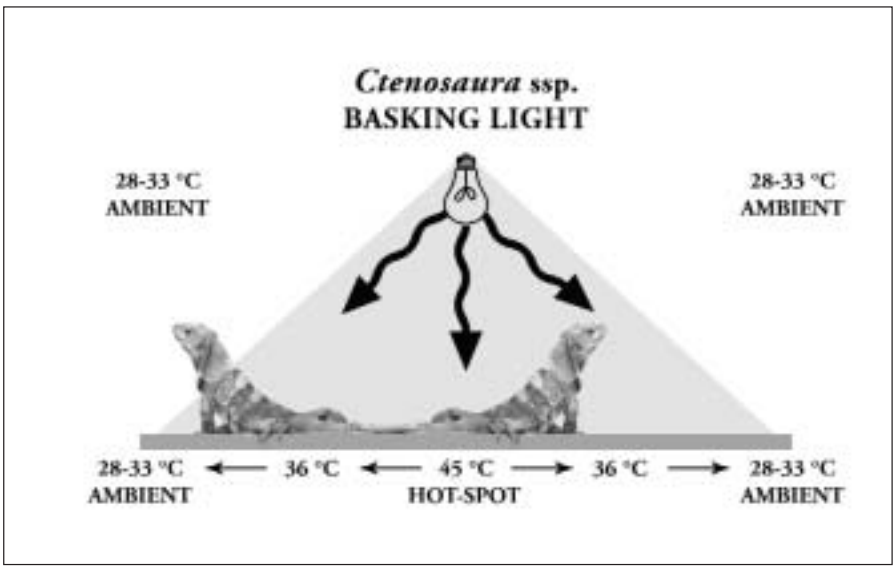
perature. In the wild, animals can maintain body temperature within a few degrees by repositioning themselves between bright sun and shade or retreating into cooler burrows. Providing temperature zones is a mandatory habitat design element to ensure good health. Since iguanas require heat to effectively digest food, inadequate thermal design of the enclosure will limit the benefits of providing a healthy nutritional diet, even with the presence of sufficient ultraviolet (UV or UVA/B) light.

In areas other than hotspots, the use of artificial rock can appear very natural and has the advantage of being light and relatively easy to clean. Artificial rock or structures can be purchased from most large pet suppliers. As an alternative for those who prefer a more "natural" setting, artificial props such as rock can be constructed. The base material of an artificial rock or prop can be made from styrofoam blocks, which are easily carved into shape with a hot knife or carving tool. The entire surface can then be covered with plaster mixed with a naturally colored powder and then modeled appropriately with a wet brush. Sharp edges should always be avoided. While still damp, the plaster can be covered with sifted sand to give the appearance of sandstone or left bare to represent some other natural rock. Covering the structure with sand helps reduce sharp edges, but it also makes cleaning more laborious and should be used only in areas unlikely to become soiled. The use of any potentially toxic or petroleum-based materials in the construction of props must be avoided.

Each component used in the enclosure should be cleaned or washed prior to use or assembly. Additionally, if the enclosure is located where insects, ants, parasites, and other undesirables might invade, some provision for preventative maintenance should be considered. Elaborate, natural-appearing habitats can be extremely difficult to rid of pests, often requiring complete disassembly to solve the problem. A preventative measure to consider during the design phase, especially if ants are a recurring problem, is construction of the enclosure so that it is elevated off the ground and the structure's waterproofed support beams fitted into a water reservoir to create an isolation barrier. Ants are of particular concern during the egg-laying season.

Sanitized driftwood or tree-limb sections obtained commercially combined with artificial plants are excellent enclosure components for providing physical isolation, and will allow animals to move from one level to another while making effective use of the three-dimensional space. Combined with artificial or natural rocks, these can produce a very naturalistic environment and simultaneously provide for the needs of the iguanas.

An inexpensive alternative to burrow construction is black plastic corrugated drain tubing, which is available in various diameters. The corrugated tubing also is useful when handling more intransigent animals. If this tubing is employed as the primary "burrow" or "hiding chamber," the animal will readily accept it and use the tube as a secure hiding location or as a sleep chamber. Once the animal is in the tube, both ends can be covered by a gloved hand, and the animal can be easily and safely transported to another location or holding pen. This method is extremely useful in transporting excitable or unruly animals from the main enclosure to an outside cage for sunlight exposure. Once the sun goes down, the animal retreats naturally to



Gradient temperature zoning is necessary for proper thermoregulation. The iguana under the basking lamp enjoys a temperature ranging from 45–36 °C, whereas the iguana on the left is exposed to a temperature ranging from 36 °C to ambient enclosure temperatures of 28–33 °C. The thermal-spread from the basking lamp to the enclosure's floor (indicated by the light gray triangle) is controlled by adjusting the height and/or wattage of the lamp. Basking lamps should have reflectors and protective screens. *Illustration by John Binns.*

Inexpensive corrugated drain tubing comes in various sizes and can be used for burrows and retreats. Tubing helps reduce territorial disputes by providing ample hiding places and allowing each individual to take ownership of a tube. *Photograph by John Binns.*

A well-secured Spiny-tailed Iguana (*Ctenosaura nolascensis*), safely buried in his "burrow," makes for easy transportation. *Photograph by John Binns.*

Corrugated drain tubing can be used to transport aggressive Spiny-tailed Iguanas. The tube provides a sense of security, minimizing stress for the iguana, and, most importantly, reducing the chances of getting bit (note the use of heavy gloves). *Photograph by John Binns.*

Corrugated drain tubing distributed around the enclosure provides protection from a dominant animal and serves to visually isolate individuals. The tubing can be placed under or behind an enclosure's artificial props to enhance the aesthetics of a "natural" setting. *Photograph by John Binns.*

its "tube," and it can then be transported back to the main enclosure with minimal disturbance and stress.

Cork tubes also make good habitat furnishings. They provide iguanas with traction for climbing and are readily accepted as sleeping places. For smaller species, the enclosure can be attractively decorated with *Yucca* and other robust plants. Enclosures for juveniles also should include plants, as these help retain humidity. For adults of the larger species (e.g., *C. similis*, *C. melanosterna*), plants only make sense if the habitat is large enough to ensure that they are out of the iguanas' reach. Otherwise, the plants will be either eaten or trampled in very short order. Artificial plants are a hardier and still attractive alternative.

A food bowl can simply be placed on the bottom of the enclosure. The use of commercially available garden cement tiles or walkway liners that keep the bowls from being upset will aid in housekeeping. Some animals, however, will not readily descend from an elevated perch, and are much more likely to eat if their food is placed higher. Driftwood structures can be used to construct a secondary platform higher in the enclosure. Although adult Spiny-tailed Iguanas normally meet all of their fluid requirements from the food that they eat, a water bowl should always be provided — and cleaned daily. In cases where territorial disputes occur, assuming the disputes do not result in injury, separate food bowls and water dishes can be used to minimize conflict.

A mixture of sanitized soil, sand, and cypress bark mulch comprises an appropriate substrate when simulating a natural environment. The use of unprocessed soil, sand, and bark mulch is not recommended due to the potential of introducing insects, bacteria, or other undesirable elements. For those concerned about maintenance, the use of artificial turf can be employed with minimal impact on the natural appearance of the enclosure. In essence, once the enclosure props are established, artificial turf floor inserts can be constructed and used as substrate pads. These can be secured using snaps, Velcro©, or quick-release locking devices. The artificial turf pads can be duplicated and replaced for ease of cleaning and maintenance. Wood shavings, corn based substrates, and newspaper are not recom-

A young *Ctenosaura similis* peeking out of a cork tube. Cork tubes provide iguanas with traction for climbing and are readily accepted as hiding and sleeping places. *Photograph by Gunther Köhler.*

Cement garden tiles or walkway borders, which are useful for securing food dishes, also may serve decorative purposes. These cement pieces are lighter than natural stone and allow considerable flexibility when designing an aesthetically pleasing enclosure. *Photograph by John Binns.*

This male *Ctenosaura flavidorsalis* was much more inclined to feed regularly when the food dish was secured in an elevated position. *Photograph by Gunther Köhler.*

mended; they are impractical and lack aesthetic appeal. Wood shavings can be accidentally ingested and can result in life-threatening intestinal impaction.

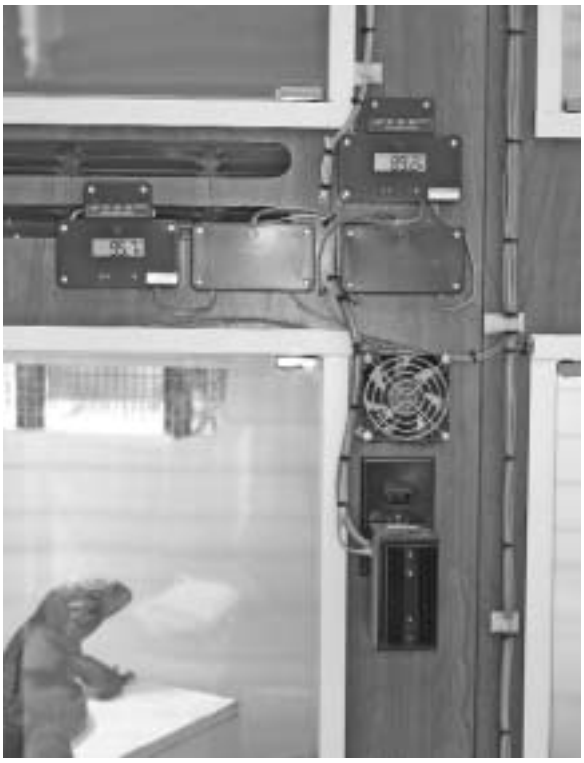
Hatchling terraria should be furnished with branches, a plant, small roots, several tubes of cork or corrugated plastic, a water dish (10–15 cm in diameter, water temperature 25–30 °C), and a heat emitter (80 W) and fluorescent tube for heat and light. A heating mat may be used to warm the water bowl from below. Hatchlings have a much higher fluid requirement than adult iguanas and should be provided with sufficient drinking water. Water bowls should be cleaned and filled daily and the terrarium misted regularly.

Heat and Light Requirements

Spiny-tailed Iguanas will be fully active and can display their intense coloration only with proper illumination. The daily photoperiod (light time) will vary by season and according to the geographic origin of the species. Regulating a consistent photoperiod as well as appropriate daily temperature fluctuations in the enclosures is recommended. To simulate the 24-hour cycle, the method of controlling light and heat should be considered prior to setting up the enclosure. Many commercially available "timers" can individually control lights and thermostats used to control the heat source, or more sophisticated electronic controllers are capable of simulating a complete 24-hour cycle (light and heat) from sunrise to sunset. Whichever method is used, installation will require careful planning. Specifics are variable, depending on the type of light and heat sources, power requirements, reliability, costs, and aesthetic considerations.

Light can be broken down into three basic categories: (1) ultraviolet or UVA/B light is required for iguanas to produce vitamin D3 (see also Bogoslavsky, *Iguana Times* 9(1–2):32–34 and MacCargar, *IGUANA* 10(3):82–85), (2) visible light reflects the combined color spectrum that collectively produces white or full-spectrum light, and (3) infrared light, which is essentially heat and is invisible to the human eye. A current trend is to combine the UVA/B and visible light spectra, and this has been successful to some degree. The types of artificial lighting available for purchase vary depending on location, and the charts provided in this article feature some of the products available in the United States. Although many products are readily available, *Ctenosaura* (and other iguanas) require higher levels of UVA/B than most other reptiles; therefore, the products selected should include lamps that produce sufficient quantities of light in the UV range. Regular ultraviolet (UV) light is critical for proper calcium metabolism and breeding.

The selection of lighting itself is complex and often confusing. Aside from determining which type of bulb to use, questions regarding fixture types, location, and mounting must be addressed. With effective planning, the various requirements (lamp types) for proper illumination can be minimized. Factors to consider in planning for proper illumination include locating the UVA/B lamp within its effective range relative to where the animal is likely to spend the greatest amount of time, the location of full spectrum lighting to best provide overall illumination of the enclosure, and basking spot lamp location or locations that facilitate the temperature zone concept mentioned previously.



This elaborate electronic habitat control system automatically controls 32 enclosures; two of those electronic control units are shown in the photograph. This system controls the lighting to simulate sunrise by slowly increasing to full intensity. Then, at a selected time, simulates sunset by slowly decreasing intensity until dark, at which time simulated moonlight is activated. The system also controls ambient temperatures that correspond to day and evening settings. Should any of the presettings fail or exceed limits, an audible alarm is activated and an auto-dialer sends a message to a beeper. A muffin-fan is activated if the enclosure overheats. All the lamps are turned off until the ambient temperature reaches safe levels. *Photograph by John Binns.*

This custom light fixture employs UV, full spectrum, and heat lamps (including a "moon" light). Custom fixtures help reduce unsightly wiring, adjustable reflectors, and screened protection for the animal. This fixture uses electrical conduit to eliminate exposed wiring. *Photograph by John Binns.*

Large outside cages on rollers are an excellent means of providing "natural" basking sites. Cages can be repositioned easily in sun or shade and the relatively large size allows an animal to reposition itself for the most effective thermoregulation. The black foam floor mat that takes up about half the shelf collects heat to provide a hot spot. The other half of the shelf is wire-mesh and is much cooler. During the summer months, a portion of the top of the cage is covered to provide shade. *Photograph by John Binns.*

Mounting of lamps is not restricted to the ceiling of the enclosure, which in very large enclosures would require lamps of very high wattage in order to be effective at floor level. To reduce the overall power requirements (wattage) of each lamp, suspension is an effective method. Suspension also enables height adjustments to fine-tune heat and UV delivery. Naturally, precautions must be taken to prevent animals from coming into contact with suspended fixtures and to ensure that all heat-producing sources have protective screening. Essentially, lower wattage UV and basking lamps can be located closer to the floor, whereas general full-spectrum illumination is mounted high in the enclosure. In some cases, the use of a single, high-power full-spectrum lamp such as sodium, mercury or metal-halide lamps in the 250-watt range is less costly than employing four 100-watt full-spectrum lamps dispersed around the ceiling of the enclosure.

Precisely calculating the proper lamp wattage can be difficult, especially if the enclosure has a complex layout. One alternative is to first select lamps of various wattages and, through testing, discover the right combination to produce the desired effect. Changing the wattage of lamps may be required to compensate for changes in ambient temperature or seasonal variations. For most types of lamps, wattage effectively translates into the ability to produce heat. However, in UVA/B lamps, wattage

ULTRAVIOLET OPTIONS
Mercury Vapor Bulbs and Fluorescent Tubes

Mercury Vapor Lamps emit a higher intensity of UVB with added benefits of UVA and full-spectrum light that help the animal produce vitamin D3 to aid in balanced calcium metabolism. All lamps are rated for use at distances from 30 cm to about 2 m. The optimum distance is about 1 m from the bulb lens. These bulbs do emit a fair amount of heat, but less heat than an incandescent bulb of comparable wattage.

Manufacturer	Brand Name	100 Watt Flood	160 Watt Flood	250–275Watt Flood	100 Watt Spot	160 Watt Spot
Zoo Med	PowerSun UV	PUV-11	PUV-10	—	—	—
T-Rex	Active UV	82404	82406	82408 (275w)	82414	82416
Full Spectrum Solutions	R40 Frosted	FSUV100	FSUV160	FSUV250	—	—
Premium Life	Mercury Vapor Globe	PI12000	PI12001	—	—	—

Fluorescent Tubes emit UVB with added benefits of UVA and full-spectrum light with very little heat. About 5–8% of the total energy output is in the UVB wavelengths, which helps to prevent metabolic bone diseases. Fluorescent tubes should be used with an incandescent (day or night) supplement to create an acceptable thermal gradient. All lamps are rated for use at distances from 25–30 cm. The optimum distance is 15–25 cm from the tube.

Manufacturer	Brand Name	14 Watt, 15" Tube	15 Watt, 18" Tube	20 Watt, 24" Tube	30 Watt, 36" Tube	40 Watt, 42" Tube	40 Watt, 48" Tube
Zoo Med	Iguana Light 5.0	FI-15	FI-18	FI-24	FI-36	—	FI-48
Hagen	Exo Terra Repti-Glo 5.0	PT-2159	PT-2160	PT-2161	PT-2163	PT-2164	PT-2165
Hagen	Exo Terra Repti- Glo 8.0	PT-2169	PT-2170	PT-2170	PT-2173	PT-2174	PT-2175
ESU	Reptile Desert 7% UVB	—	RP393	RP390	RP391	—	RP392
ESU	Super UV (3%UVB + 7%UVA)	RP454	RP453	RP450	RP451	—	RP452
Vita-Lite (also has 75w, 96" tubes)	—	—	VL-06402	VL-3028	VL-1064	—	VL-06418

can be misleading relative to their ability to produce heat, which is significantly less than a comparable visible spectrum lamp of the same wattage.

Selection of lamp type should be based on performance, longevity, and aspects of enclosure design such as size, shape, and materials (hard-walls, wire-screen, etc.) used. In general, as the size of the enclosure increases, so does the requirement for light and heat (wattage). For small indoor enclosures, in which ambient temperatures remain relatively constant, the amount of heat produced in lamps must be checked and allowances made for adequate air-ventilation to prevent the enclosure from overheating. Conversely, maintaining temperatures within allowable limits within a screened enclosure located in an area that is subject to large ambient temperature fluctuations can prove to be a challenge. This situation often leads to the use of additional heat sources and controllers to compensate for temperature variations.

As a final word on illumination, no light supplement for captive animals is better than natural sunlight. Regular periods of exposure, when possible, should be employed. In designing enclosures, any access to natural sunlight (window, porch, skylight, etc.) should be optimized. To utilize the sun's UV, glass and plastics need to be replaced with UV-transmittable substitutes.

Ambient temperatures in an enclosure should range from 28–33 °C during the day and be reduced to 18–24 °C at night. Heat can be generated by the lamps illuminating the enclosure as well as by specific heat producing lamps or ceramic heaters. During the peak summer season, the total illumination wattage may need to be reduced in order to keep the enclosure within

VISIBLE LIGHT OPTIONS (INCANDESCENT DAYLIGHT)

Daylight Blue and Basking Spot Bulbs

Incandescent bulbs emit full-spectrum light, limited UVA, and an abundance of heat. Flood lamps create a larger heated area and spot bulbs create a more concentrated heated area.

Flood Bulbs

Manufacturer	Brand Name	40 Watt	60 Watt	100 Watt	150 Watt
Zoo Med	Daylight Blue	DB-40	DB-60	DB-100	DB-150
T-Rex	Day Blue	TR82322	TR82330	TR82332	TR82334
Hagen	Day-Glo	PT-2104	PT-2110	PT-2112	PT-2114
Hagen	Exo Terra Sun Glo			PT-2111	
ESU	Brightlight	RP409	RP410	RP411	RP150

Spot Bulbs

Manufacturer	Brand Name	50–60 Watt	75 Watt	100 Watt	150 Watt
Zoo Med	Repti Basking	SL-50	SL-75	SL-100	SL-150
Zoo Med	Repti Halogen	HB-50	HB-75	HB-100	HB-150
T-Rex	Basking Clear	TR82390	TR82394	TR82396	
T-Rex	Daylight Blue	TR82360	TR82362	TR82364	TR82366
Hagen	Exo Terra Sun Glo Basking	PT-2131	PT-2132	PT-2133	PT-2134
Hagen	Day-Glo Basking	PT-2135	PT-2136	PT-2138	PT-2140
ESU	Reptile Brightlight Spot	RP413		RP414	RP415
Vita-Lite	Basking Spot	DL4644		DL4647	

allowable temperature limits. If using lower wattage bulbs, providing increased ventilation, and eliminating other sources of heat proves ineffective, air-conditioning may be necessary.

Air conditioning was necessary in this vivarium to solve the problem of overheating during the summer months. This particular vivarium houses a variety of species, each with specific ambient temperature requirements that could not be solved by lowering lamp wattage. The skylight above the compact air conditioner brightly illuminates the inside of the vivarium during daylight hours. *Photograph by John Binns.*

The central zone of the main basking area should have a hotspot reaching 45 °C. This can be produced using a single lamp source or combination of lamps such as spotlights, infrared lights, ceramic heaters, and UV lights, depending again on the particular design of the available lamps and the nature of the enclosure. Further considerations must include a declining temperature zone on an approximately level plane from the central hotspot to the ambient enclosure temperature of about 28–33 °C. Although possibly restricted by limited space, the more gradual the decline in temperature, the more latitude the iguana will have in selecting the proper temperature zone. The temperature gradient can be established by adjusting the height of the basking spot lamp or lamps. Raising and lowering the basking lamps may require a change in wattage to produce the desired temperature. The use of other basking spots can be incorporated at higher levels of the enclosure, but these do not need to be as finely tuned as the main basking spot.

For most species, the relative humidity during the day should be about 50–60%, climbing to 70–80% at night. For particularly low humidity locations, a plastic tub filled with water can be used to increase humidity by evaporation. During the rainy season (May to November), depending on the ambient humidity where you live, the entire habitat should be thor-

INFRARED (INCANDESCENT LIGHT AND HEAT) EMITTERS

Incandescent night bulbs emit low levels of visible light in both flood and spot lamps (red and black glass). Infrared bulbs and ceramic heat emitters are appropriate for nighttime use, as they generate radiant heat and little or no light.

Flood Bulbs

Manufacturer	Brand Name	40 Watt	50–60 Watt	75 Watt	100Watt	150 Watt
Zoo Med	Nightlight Red	NR-40	NR-60	—	NR-100	—
T-Rex	Nocturnal Black	TR82326	—	TR82340	TR82342	TR82344
Hagen	Night-Glo	—	PT-2141	PT-2142	PT-2144	PT-2146
ESU	Nightlight bulb	RP419	—	RP 420	RP 421	RP 422
ESU	Red Basking Night	—	RP 402 (50 Watt)	RP	403 RP	404

Spot, Infrared, and Ceramic Bulbs

Manufacturer	Brand Name	50 Watt	60 Watt	75 Watt	100 Watt	150 Watt
Zoo Med	Infrared	RS-50	—	RS-75	RS-100	RS-150
T-Rex	Day/Night Red	TR82380	—	TR82382	TR82384	TR82386
T-Rex	Nocturnal Black	TR82370	—	TR82372	—	—
ESU	Nightlight Spot	—	RP 423	—	RP 424	RP 425

Ceramic Heat Emitters

Manufacturer	Brand Name	40 Watt	60 Watt	80 Watt	100 Watt	150–165 Watt	215 Watt	250–265 Watt
Zoo Med	Repticare		CE-60		CE-100	CE-150		CE-250
ESU	Bask N' Heat	RP480	RP481	RP482	RP483	RP484	RP485	RP486
Hagen	Exo Terra Heat	PT-2040	PT-2045		PT-2046	PT-2047		

oughly misted at least once a day to simulate rainfall. Enclosure components should be able to withstand misting and electrical components should be avoided. During the dry season, misting two or three times each month is sufficient. *Ctenosaura bakeri* is an exception and has some very specialized care requirements, as their natural habitat is wet mangrove swamp (see, for example, Gutsche, *IGUANA* 10(2):28–29).

This large Rhinoceros Iguana (*Cyclura cornuta*) takes full advantage of the UV and heat lamps overhead. The "lizard hut" is used to facilitate basking close to the lamps and also provides a sleeping site. *Photograph by John Binns.*

Population Density and Socialization

Adult males cannot be kept together. They are territorial and are likely to injure each other. A single male with one or two females can be housed together. Incompatibility and biting is sometimes observed even between females, and separating them into individual enclosures may be unavoidable. Juveniles of the larger species tend to be particularly quarrelsome. Usually, one individual will quickly assume the dominant position and begin to oppress the other lizards. In order to ensure that all animals thrive, any that are repeatedly chased away from food and basking spots must be separated. Juveniles should never be held with adults, as they may be regarded as prey.

The larger species of ctenosaurs can be kept with Green Iguanas or Tegus (*Tupinambis teguixin*). The smaller species, such as *C. clarki* or *C. defensor*, can be kept with Chuckwallas (*Sauromalus*) or the larger species of Spiny Lizards (*Sceloporus*).

Ctenosaura bakeri exhibit at the Frankfurt Zoological Garden illustrates the complexity necessary to house a breeding group of Spiny-tailed Iguanas in a single enclosure. Note also the large "pond," necessary for maintaining the high humidity critical to these mangrove swamp-dwelling lizards. *Photograph by Gunther Köhler.*

This juvenile *Ctenosaura similis* is eating an hibiscus flower. Like many other iguanid lizards, Spiny-tailed Iguanas respond positively to brightly colored blossoms. These are sometimes effective in inducing an otherwise reluctant eater to feed. *Photograph by Gunther Köhler.*

Unlike Green Iguanas, Spiny-tailed Iguanas are omnivorous. This female *Ctenosaura bakeri* is eating a cricket in the wild on Utila Island, Honduras. *Photograph by Gunther Köhler.*

This captive-bred *Ctenosaura similis* readily accepts a dandelion flower. Supplementing purchased foods with items collected in the yard or garden helps to ensure a varied diet. Note, however, that plants sprayed with pesticides or other lawn chemicals are not suitable for use as food. *Photograph by Gunther Köhler.*

Generally, however, species with different habitat needs or those that may be viewed as potential prey (e.g., smaller lizards) should not be housed with ctenosaurs. Keeping ctenosaurs together with turtles is not recommended, since turtles often pass amoebas (e.g., *Entamoeba invadens*), and an amoebic infection is often difficult to treat in herbivorous lizards.

Closely related species from the same subgenus should not be kept together for breeding purposes, because this may result in unwanted hybridization. Accurately identifying the species one acquires for breeding is vitally important, especially in cases where animals are acquired from different sources. Since *Ctenosaura* is not commonly kept in the private sector, a specialist should be consulted for identification. This can be done through the use of photographs and other transmittable data. The keeper must preclude any chance of hybridization. *Ctenosaura oaxacana* and *C. quinquecarinata* have hybridized in captivity. Even under natural conditions, hybridization is known to occur between individuals from different subgenera, such as *Ctenosaura bakeri* and *C. similis*. However, if hybrid animals resulting from irresponsible breeding enter the pet trade or are passed to other breeders and not identified as hybrids, this would quickly contaminate the species' captive gene pool.

Nutrition

Spiny-tailed Iguanas are omnivorous. Juveniles, however, prefer animal-based foods. Between 40 and 80% of the food consumed by young *C. similis* (SVL around 10 cm) consists of insects. In contrast, adult Spiny-tailed Iguanas are predominantly vegetarian. Vegetables, such as sweet potatoes, squash, and green beans, as well as leafy greens, such as dandelions, collard greens, mustard greens, escarole, and chicory are readily accepted. Various seeds and sprouts (linseed, sunflower, soy beans), flowers (dandelions and hibiscus), and fruit (nectarines, peaches, pears, apples, melon, berries, plums) are good supplements. The colors red and yellow are particularly attractive to Spiny-tailed Iguanas (as they are for many other reptiles), so hibiscus flowers, grated carrots, tomatoes, strawberries, dandelion flowers, and other red or yellow foods are usually consumed greedily and often may be used to convince reluctant eaters to feed.

Food should be offered daily and should always include as much variety as possible (see dietary recommendations for Green Iguanas in Barten, *IGUANA* 10(4):129–141; these generally apply to adult ctenosaurs as well). All food items should be washed, chopped into small pieces, and well mixed. During the summer, leafy garden plants (dandelions, clover, mulberry leaves, raspberry leaves) can comprise a large portion of the diet. During the winter, various leafy cooking greens and sprouts can be substituted. Food remnants should be removed daily and food bowls cleaned thoroughly. Some foods contain harmful substances and should be fed only in very limited amounts. These include oxalates (in rhubarb, sorrel, and spinach), nitrates and saponin (particularly in spinach and comfrey), and goitrogens (in cabbage).

Animal protein should be provided 1–3 times per week. This can include all types of commercially available insects such as crickets, grasshoppers, wax moths and their larvae, meal worms, superworms, and giant cockroaches.

Mineral supplements should be added to food daily. All insects should be dusted with mineral powder before they are offered. In addition, a regular vitamin supplement must be provided. Many vitamin supplements are available commercially, but caution is advised. Overdosing or excessive use of these supplements can result in a number of nutritional disorders. Owners should consult their iguana veterinarian to establish a dietary supplement program. This is especially true when considering fat-soluble vitamins, such as A and D, where overdosing is particularly dangerous.

First foods offered to hatchlings should be wax moths and small crickets. Finely chopped and well-mixed vegetables also should be offered daily, although the little lizards will most likely prefer the insects. Hatchlings should receive a mineral supplement containing calcium. With a poor diet, fast-growing juveniles can develop bone disease such as rickets and fibrous osteodystrophy, which are difficult to treat (see also Gutman, *Iguana Times* 9(1–2):35–37).

References

Braun, D. 1993. Erfahrungen bei der Pflege und Zucht von *Ctenosaura palearis. Iguana Rundschreiben* 12:13–18.

Köhler, G. 1992a. Artgerechte Ernährung und ernährungsbedingte Erkrankungen des Grünen Leguans, *Iguana iguana* (Linnaeus 1758). *Sauria* 14:3–8.

Köhler, G. 1992b. Die Bedeutung von *Entamoeba invadens* bei der Vergesellschaftung von Echsen oder Schlangen mit Schildkröten. *Sauria* 14:31–34.

Köhler, G. 1993. *Schwarze Leguane. Freiland Beobachtungen, Pflege und Zucht.* Herpeton Verlag, Offenbach.

Köhler, G. and E. Blinn 2000. Natürliche Bastardierung zwischen *Ctenosaura bakeri* und *Ctenosaura similis* auf Utila, Honduras. *Salamandra* 36:77–79.

Van den Heuvel, W. 1997. De Zwarte Leguaan *Ctenosaura palearis* in zijn natuurlijke omgeving en de voortplanting in het terrarium. *Lacerta* 55:155–159.

Van Devender, R.W. 1982. Growth and ecology of Spiny-tailed and Green iguanas in Costa Rica , with comments on the evolution of herbivory and large body size, pp. 162–163. In: G.M. Burghardt and A.S. Rand (eds.), *Iguanas of the World: Their Behavior, Ecology and Conservation.* Noyes Publications, Park Ridge, New Jersey.

PROFILE

Gordon Burghardt: Forty Years of Studying Reptilian Behavior

Arthur C. Echternacht

University of Tennessee

In August 1979, scientists who were studying the systematics, behavior, ecology, physiology, and conservation of iguanas met to compare notes and take part in a symposium held at the University of Tennessee, Knoxville. The symposium was organized by Gordon M. Burghardt of the University of Tennessee and A. Stanley Rand of the Smithsonian Tropical Research Institute (STRI) in Panama. It led to *The Iguanas of the World: Their Behavior, Ecology and Conservation* (1982. Noyes Publications, Park Ridge, New Jersey). Edited by Burghardt and Rand, the volume quickly became something of a bible for those of us interested in the biology of iguanas. In 1997, a similar symposium, held at the University of Washington in Seattle, resulted in the second in what will hopefully become a continuing series devoted to these fascinating lizards (Alberts et al., eds. 2004. *IGUANAS: Biology and Conservation*. Univ. California Press, Berkeley; see review on p. 60). Forty-two biologists contributed to the latest volume and it was dedicated to Gordon Burghardt and Stan Rand. Gordon was the only individual to contribute to both the 1982 and 2004 volumes.

Gordon was born in Milwaukee, Wisconsin and remembers being drawn to reptiles at the age of about eight. Although he initially majored in Chemistry as an undergraduate at the University of Chicago, he soon became aware of the program in biopsychology and changed majors. His adviser was Eckhard H. Hess. Hess knew that the behavior of reptiles had received little attention from ethologists (scientists who study the natural behavior of animals) and encouraged Gordon, while still an undergraduate, to become involved in research. A problem, however, arose. Gordon's primary interest was in snakes, and Hess's wife hated snakes. She had extracted a promise from her husband that none would be allowed in his laboratory. As a result, the man who would later conduct research on giant iguanas began small, by studying the feeding behavior of Green Anoles (*Anolis carolinensis*) and Five-lined Skinks (*Eumeces fasciatus*). This work led, in 1964, to the first of over 150 research papers, books, and book chapters that Gordon has published to date. Despite the subjects of that first study, Gordon was still determined to study snakes and the opportunity arose when he was given a pregnant garter snake. Unable to keep it in Hess's lab, he set it up in his studio apartment and, before long, he had an entire litter of snakes, each housed in its own small cage and all squeezed into his small apartment — and that was where he began the research on the feeding behavior of snakes that has been a hallmark of his career. This research became the basis for his doctoral research and, fortunately, by the time he entered graduate school, Hess had found a way for him to house snakes in his laboratory.

A recent photograph of Gordon Burghardt (and friend) in his office at the University of Tennessee. *Photograph courtesy of the University of Tennessee Photography Services.*

After receiving his Ph.D. in Biopsychology, Gordon taught biology at the University of Chicago for about a year and a half before joining the faculty of the Department of Psychology at the University of Tennessee, Knoxville. He presently holds a

joint appointment in that department and in the Department of Ecology & Evolutionary Biology (EEB). Until it was merged into EEB, he directed the Graduate Program in Ethology, which he had founded. He directs the research of undergraduate and graduate students in both Psychology and Biology and teaches, among other courses, the popular Comparative Animal Behavior Laboratory course (the "CAB lab"). Very active in several professional societies, he is Past-President of the Animal Behavior Society, a member of the Editorial/Advisory Board of the International Iguana Society, the IUCN Species Survival Commission Iguana Specialist Group, and the AZA Komodo Dragon Species Survival Plan management group grant panel. Virtually all of his research has involved living animals, and he is a very active advocate for the ethical treatment of all animals used in research.

He has been a strong proponent of collaboration between university-based biologists and their zoo-based counterparts, and several of his graduate students have conducted research in zoos. He served for many years on an advisory board for the Knoxville Zoological Park and once provided a foster home for a young lion in his basement, which became an effective security device when the need arose. Having broken the glass in a basement door, the would-be burglar apparently encountered the lion, which was no longer a small cub and had the run of the house. One has to guess what happened but, whatever ensued, the burglar left in an apparent rush. Not only was nothing stolen, not even the camera equipment in plain view, but the hammer used to gain entry was left behind on the floor. Gordon also fostered two orphaned bear cubs, which led to a long involvement with studies of Black Bear behavior, including bear-human interactions.

In 1973, Gordon attended a meeting of herpetologists in Costa Rica and, afterward, visited the STRI facility on Barro Colorado Island (BCI) in Panama. Although he was there to study snakes, his attention was drawn to the large numbers of baby Green Iguanas (*Iguana iguana*) that were basking and feeding in the shrubs around his cabin. At the time, Stan Rand was studying the nesting behavior of adult iguanas, but no one was studying the hatchlings. Gordon soon returned to BCI and initiated what was to be a long series of studies on the nesting behavior of female iguanas, the emergence and dispersal of hatchlings, and various aspects of adult behavior. He was joined in these studies by an army of undergraduate, graduate, and postdoctoral students from the United States and Latin America.

Gordon Burghardt in full field mode demonstrating the proper use of a "stump-ripper" to students prior to a safari around his cabin in the wilds of eastern Tennessee. *Photograph by Paul T. Andreadis.*

A blind used by Gordon Burghardt and his students to study the nesting behavior of Green Iguanas on Slothia, an islet adjacent to Barro Colorado Island, Panama. *Photograph by Gordon Burghardt.*

Many of these studies were carried out on Slothia, a small (0.3 ha) islet in Gatun Lake near BCI. Aside from its proximity to the STRI facility on BCI, Slothia was ideal for these studies because, working from a blind, the iguanas could easily be observed. Stan Rand had found that over 100 female iguanas migrated to Slothia yearly to nest communally in a small (8 x 6 m) clearing. In this crowded environment, each female aggressively defended her nest against others who were intent on appropriating a partially completed nest or who might, in the process of digging their own nests, uncover and scatter her eggs. They all shared space with American Crocodiles (*Crocodylus acutus*). This was an uncomfortable arrangement, at least for the iguanas and the biologists: the crocodiles occasionally ate an iguana and Gordon has very dramatic film footage, taken in the course of observing iguanas, of a huge crocodile quite unex-

Hatchling Green Iguanas emerging synchronously from their nest chamber on Slothia. *Photograph by Gordon Burghardt.*

Stan Rand (left) and Gordon Burghardt relaxing aboard a research vessel on the return trip from the Archipélago de las Perlas in the Bahía de Panamá, where they had been studying the nesting behavior of Green Iguanas. *Photograph courtesy of Gordon H. Rodda, photographer unknown.*

pectedly launching itself out of the water and coming to rest directly in front of the blind.

Among the results of that research, we now know that hatchling iguanas, like hatchling Green Sea Turtles (*Chelonia mydas*), emerge synchronously from the nest chamber. They remain on Slothia for a few days before rapidly dispersing in groups by swimming to the adjacent mainland. For up to a year following emergence from the nest, most baby iguanas remain in groups, and Gordon and Rand have shown that, on BCI, the growth rates of iguanas in these groups is higher than those that adopt a solitary existence. A partial, but substantial, list of publications on iguanas by Gordon and his collaborators can be found in his chapter in *IGUANAS: Biology and Conservation.*

All the while Gordon was conducting research on iguanas, he also was building on his earlier studies of snake behavior and ecology. The chemical senses, especially those associated with the vomeronasal or Jacobson's organ (vomerolfaction), are very important to snakes and are especially critical in, among other things, prey identification. In his early research, Gordon established what have become the standard methods for studying the chemical cues that elicit predatory responses in snakes. He has been especially interested in whether the attraction to a particular type of prey (or, more accurately, prey chemical) is inherited, implying an evolutionary basis, modifiable by experience, and whether preferences change ontogenetically, that is, as a snake ages. These interests also have led him to study geographic variation in prey preferences within a single species and among closely related species. Much of this work has involved North American Garter Snakes (*Thamnophis* spp.) and Water Snakes (*Nerodia* spp.), and his lab is typically full of converted plastic shoe boxes, each housing an individual new-born snake.

Recently, he has been involved in an effort to save an important piece of the habitat of Butler's Garter Snake (*Thamnophis butleri*), which had been threatened by land development in Milwaukee, Wisconsin. A group of developers had asked the state to remove the snake from the state's official list of endangered and threatened species. As of this writing, Gordon's efforts, and those of others of like mind, have won, at least temporarily. In January, a state legislative panel directed the Wisconsin Department of Natural Resources to formulate a plan for protecting the species from developers.

Gordon's snake research has occupied most of his time lately, but he has broadened the scope of his studies to include consideration of the enrichment and psychological well-being of reptiles, the behavior of Monitor Lizards (*Varanus* spp.), and play behavior, cognition, and visual perception in reptiles and fish. His book on animal play will soon be published.

In a rather radical departure from his research on reptiles, he soon will leave Tennessee temporarily to study amphibians at the National Amphibian Conservation Center at the Detroit Zoo. Iguanas, however, are never far from his mind, and he continues to be a valuable source of information, advice, and assistance to anyone studying these lizards. One gets the impression that it wouldn't take much to lure him back into the fold on a more active basis.

If you would like to learn more about Gordon's activities, you can visit his web site: http://web.utk.edu/~gburghar.

What Goes Around Comes Around

When Allison Alberts, who was featured in the profile in *IGUANA* 10(4), decided to change her major from English to biology, the decision was based, at least in part, on her experiences during the herpetology unit of a two-semester course on the "Natural History of Vertebrates." That unit was taught by Harry Greene, who had been one of Gordon Burghardt's students at the University of Tennessee. Yet another of Gordon's students, Paul J. Weldon, had earned his doctorate working on snake behavior. Later, when Paul was on the faculty at Texas A&M University, one of his post-doctoral students was none other than Allison Alberts.

HISTORICAL PERSPECTIVES

The Iguana[1]

Franz Werner

Characteristics of the genus *Iguana Laur.* [translator's note: "Laur." refers to Josephus Nicolaus Laurenti, who first formally described the Common or Green Iguana] include the elongate, laterally compressed body, a large, quadrangular head, a short neck, powerful limbs, exceedingly elongate toes, and an extremely long tail with keeled scales throughout, a distinct dewlap with an anterior border of spike-like scales, a middorsal row of enlarged spines that extend from the nape to the tip of the tail, multi-sided head scales of various sizes with alternately arched, tuberculate, or keeled surfaces, smooth or slightly keeled ventral scales, triple-keeled scales on the undersides of toes, distinct femoral pores, a large, round tympanum, wide nares, and dentition with the anterior-most teeth peg-like, sharp, and with a slight inward tilt, and others three-edged and, distinct from most related genera, serrated along the edge. In addition to the jaws, the sphenoid and pterygoid bones also bear a double row of small teeth, the numbers of which, like those on the jaws, vary by age.

The iguana, *Iguana tuberculata* Laur. [an alternative name for *Iguana iguana* that was widely used well into the 20th century], reaches 1.4–1.6 m in length, of which 1 m or more consists of tail. Ground color is an attractive leaf green. Very young individuals lack markings, but the rump and tail of larger animals bear distinct dark, often light-outlined crossbands. The underside is white or yellowish.

All iguanas are found in tropical South America, the nations surrounding the Gulf of Mexico, and several of the Lesser Antilles. All live in trees, particularly those along the banks of streams or lakes. There they move about with consid-

[1] Excerpted and translated from Franz Werner (1913. Die Lurche und Kriechtiere von Alfred Brehm. Zweiter Band: Kriechtiere (Schuppenkriechtiere), pp. 92–98 + table "Lizards IV," no. 3. In: O. z. Strassen (ed.), *Brehms Tierleben. Allgemeine Kunde des Tierreichs.* 4th ed. Bibliographisches Institut, Leipzig and Wien. Translated by R. Powell.

Iguana, *Iguana tuberculata* Laur. 1/7 natural size. Photograph from the Zoological Garden in Frankfurt a/Main by A. Fahr-Darmstadt.

erable dexterity, climbing or jumping from limb to limb. They also are quite adept at retreating into the foliage, rendering themselves invisible to the untrained eye. Toward evening, they frequently descend to the ground in order to forage — but, if threatened, they rapidly seek the highest branches whenever possible, or, as we already know, the depths of any nearby water. In the latter, they are as much at home as monitors [these are generally large lizards in the family Varanidae; all are found in the Eastern Hemisphere; some are quite aquatic in their habits]. The powerful tail is used as a combination oar and rudder and is capable of propelling them with surprising speed. They swim, as do all lizards, with all four limbs securely adpressed along their bodies, relying exclusively on their tails for propulsion and steering. In such a fashion, they are fully masters of the water. In addition, they are equally as adept at diving as at swimming, and are capable of spending considerable periods of time submerged in the depths. They do not tire while under water and, as a consequence of their skill, effectively evade any dangerous enemies unable to follow them into what is essentially a foreign element. They seem not the least concerned about crocodiles or caimans, many of which are found in the waters into which these lizards unhesitatingly venture.

Duméril [André-Marie-Constant Duméril, the foremost taxonomic herpetologist of his era] noted that he found only plant materials in all of the iguana stomachs he had examined, and others have agreed. Sumichrast [a naturalist] indicated that soft berries had been consumed in such quantities by the specimens that he had dissected that their intestines were extraordinarily distended. Tyler [another naturalist] indicated that, among the half-digested leaves he had found in the digestive tracts of iguanas, were innumerable quantities of small worms that, he assumed, had been on the leaves consumed by the lizards and inadvertently swallowed. The main dietary component surely consists of plant materials such as fruits and leaves, but we also know beyond any doubt that younger animals gladly take insects and, as testified by Tyler, earthworms and snails.

Typically, adults flee at the first sight of humans, mainly because they have learned to view them as their most dangerous enemy. In contrast, young animals sit quietly and are consequently easy to catch. However, if iguanas are forced into a corner, they defend themselves valiantly, initially inflating their bodies, extending their dewlaps, and hissing, then jumping at their opponent while attempting to bite. Once their jaws have a firm grip, they are quite unwilling to let go. Because the overlapping molars are very sharp, they leave a bite that bleeds freely, much like a wound caused by a knife. At the same time, the tail is used to inflict powerful, painful, and even dangerous blows.

During the breeding season, iguanas are said to be even more excitable and considerably more aggressive than usual, never leaving a chosen female while furiously attacking any animal that ventures too near. Even battles among males for possession of females are grim and frenzied. Well after the breeding season, females appear in the vicinity of sandbanks, in which they intend to lay their eggs. During this period, one can most readily see these animals, which typically spend the rest of their lives making every effort to remain invisible. On St. Lucia, egg deposition occurs during the months of February, March, and April. The eggs are about the size of those laid by pigeons, white or light straw-yellow in color, and have soft shells, the latter reminiscent of fine glove leather. Like those of most reptiles, the eggs are composed almost entirely of yolk. The females lay the eggs in holes dug in the sand, which they then carefully cover. Beyond that, they show no concern for the brood. However, Göldi [Emílio August Goeldi, a Swiss-born Brazilian naturalist for whom the famous Goeldi Museum in Pará at the mouth of the Amazon River was named] noted that a captive female attacked him vigorously as he attempted to examine her recently deposited eggs. Reports indicate that older females lay considerably more eggs than younger individuals. A female held in captivity by Göldi, for example, laid five eggs on one day and 32 more five days later. In a series of dissected specimens, 8, 14, and 17 eggs were found in increasingly larger females. Eggs were arranged in distinct rows on each side of the body cavity and were all about equal in size. Sumichrast noted that, in his experience, several females commonly laid eggs in a communal nest, so that one could on occasion find as many as ten dozen eggs in a single cavity. Many eggs are destroyed not only by ants but also by small mammals, especially the so-called muskrat found on St. Lucia [not the better known muskrat of North America]. Consequently, female iguanas may purposely seek out the seacoast, the sand of which is considerably less accessible to its enemies than the banks of rivers. Hatchlings appear to stay together for extended periods, as A[lexander]. v[on]. Humboldt [another famous German naturalist whose explorations of South America thrilled Europe and inspired Darwin] mentioned that his guide showed him a nest filled with 10 cm-long iguanas. "These animals were hardly distinguishable from a common lizard; the prominent dorsal crest scales, the large, erectile scales, and all of the dangling appendages that provide the iguana, when he is 1–1.5 m long, with such a fierce countenance, were barely present in these beginners."

In the West Indies, the idea that iguana meat is unhealthy is prevalent throughout the region. Nevertheless, no one pays much attention to that opinion, searching instead, almost with the same zeal as the members of Schomburg's party [reference unknown], for such tasty table fare. Catesby [Mark Catesby, an English naturalist] said that iguanas were common and profitable trade goods, caught by hand and passed along, until, in the end, they were bought as delicacies by rich mainlanders. The meat is considered to be easily digestible, nourishing, and tasty; it is fried or, more frequently, stewed. The eggs, which do not harden with cooking, are almost devoid of eggwhite; they are typically used in the preparation of broth. Talented collectors specialize in the search for this rather wonderful fare and use several different methods to capture animals. One of Schomburg's reports describes a rather unusual technique that some have disputed but several other writers have mentioned. Because the lizards are reputed to be quite curious, they extend their heads when approached, allow themselves to be stroked with a belt until it is tightened sufficiently to allow the animal to be effectively noosed. Once firmly in place, the tether is used to forcefully tear them from their arboreal perches. The iguanas obviously fight like crazy to free themselves, opening their powerful jaws, snarling and hissing — but, of course, are easily overwhelmed. The snout is secured with a loop of string and the body and limbs are tightly strapped. In this helpless position, the

iguanas are then taken to the market. I am loath to decide just how much if any of this tale is true. I do consider it possible that these curious creatures allow the collector to approach closely, at least in areas where they are seldom hunted. More commonly, trained dogs are used, particularly since, without their help, finding the lizards, artfully hidden amongst the foliage, is almost impossible. Liebmann [yet another naturalist] reported that, along the west coast of Central America, lizards are ambushed and cornered by dogs when they descend from their trees in the evening, Tyler expanded on this by noting that dogs were trained specifically for this task. Experienced dogs probably use their sense of smell to locate iguanas and then bark to draw the hunters to the tree in which the lizard is roosting or, if encountered on the ground, hold it until their masters arrive. Some dogs undoubtedly do not hesitate to grab the iguana by its back and shake it until it dies. For all that, a few dogs, those that have learned from experience and those that aren't particularly bright, fear the tail and teeth of a frenzied and frightened iguana. If the lizard does manage to flee, it almost invariably turns first to a tree; if, however, unable to find one quickly, it will just as readily seek shelter in a cave or crevice — in either case, it is probably lost. An iguana, seemingly secure in the foliage, is relatively easily shaken from a perch or the branch on which it rests can be cut. If in a cave, an iguana will often think itself secure if only its head is hidden. Once successfully in hand, in order to prevent being bitten, the hunter will run a tough stalk through the skin under the chin and out a nostril; tying the ends to render the mouth secure. Then, using the long tendons of the middle toes, the limbs are secured behind the back. Thus trussed, the tortured captive is taken to market the next morning. Because Mexicans are very familiar with the tenacity of iguanas, that often escape even after being shot in the body, such securely tied individuals may be held for months until eventually sold. This often occurs prior to festivals, during which iguanas are particularly prized when baked in corn tortillas and eaten as delicacies. They also may serve as special gifts.

Occasionally, one might find among the entrails what appears to be half an egg. In earlier times, these were considered to be powerful drugs with great healing properties, and may, from place to place, still be viewed as such today.

Initially, captive iguanas are wild and may be particularly vicious, biting their masters and threatening any animal that ventures too near. They may even kill weaker pets that enter their domains, including fellow captives. Over time, their frenzies calm and, in the course of several weeks, they become so tame that anyone can touch them.

Emílio Goeldi on Iguanas

Of recent observers, Goeldi in particular has contributed greatly to expanding the horizons of our knowledge about the lifestyles of iguanas. "The iguana, commonly called 'camelaão' by Brasilians, is encountered with increasing frequency as one progresses from Bahia to the north. Sightings in the vicinity of the Amazon River and along the coast of Guahana are daily occur-

Iguana, *Iguana tuberculata* Laur. 1/6 natural size.

rences, with an understanding that, within such larger regions, specific sites with proper topographical and vegetative features will be preferentially occupied. Conversely, iguanas avoid localities that fail to provide the resources necessary for survival. This is particularly evident, for example, here in Pará [the Brasilian state at the mouth of the Amazon]. Single iguanas are encountered only from time to time in the vicinity of the city and on adjacent islands. In contrast, during a short rowboat ride along Marajó Island, especially its southeastern part, one can see hundreds of individuals. I've also found them to be astonishingly common at Cape Maguarí and along the Atlantic Coast. Such numbers of iguanas inhabit several smaller islands, located from the immediate vicinity of Cape Maguarí to several hours away, that they are rightly considered to be their most abundant inhabitants and, further, over time they have proven themselves capable of dramatically altering the vegetation. I am quite familiar with two of these little islands, 'Ilha Camaleão' and 'Ilha Machados,' the latter of which I visited in early September 1896. Our gracious host, the owner of the island (and, coincidentally, the discoverer of *Lepidosiren paradoxa* on Marajó), blamed the untold numbers of iguanas living on the island for the extirpation of the native mangrove forest.

"The iguana is a vegetarian of the purest sort, a fact that, to my surprise, I fail to see reflected in the herpetological literature. Just in the immediate vicinity, iguanas make a major impression on the constitution of the plant communities; for example, on (1) mangrove trees (*Avicennia*), (2) thorny aturia bushes (*Drepanocarpus*), and (3) quick-growing anhinga stands (*Montrichardia*). These three plants obviously serve as the main foods for iguanas.

"During most of each year, the iguanas, as is characteristic of the species, live a happy and worry-free life in this hot, moist climate — as long as something to eat is available. A paucity of food is not likely in most cases, unless one is dealing with an isolated island, such as the examples cited earlier, combined with an overpopulation of lizards. In such cases, largely as a consequence of their own actions, iguanas may experience hard times during the dry seasons in these deserts of their own design. Animals may be severely emaciated and so feeble that they are hardly able to move. Such instances arouse our pity, particularly in contrast with their brethren who thrive along riverbanks where an abundance of fare prevails.

"If one glides slowly and quietly along in a rowboat, one can see iguanas left and right, so to speak, at every step. Some are perched on the highest branches of the airy mangroves, whereas others rest among the colorful garlands of the arribidaea bushes. The inexperienced novice first notices the older, larger individuals whose boldly patterned bodies are quite evident. In contrast, a more practiced eye is necessary to see juveniles or lizards that have recently shed. While basking motionless on their perches in the hot sun, their beautiful green dresses blend seamlessly with the juicy leaves of the vines that often garnish the tops of the anhinga bushes. As a rule, they hold their positions until one approaches all too near — but once the decision is made to flee, one is astounded by their unexpected adroitness. Iguanas are masterful swimmers and divers, and an individual that falls in the water must be considered lost unless bearing deadly wounds. Killing an iguana is not easy. They are unbelievably tough, and only a shot through the head or vertebral column will guarantee a catch.

"By the end of August, one begins to find gravid females about ready to lay their eggs. Yellow ovarian follicles collectively resemble a voluminous cluster of grapes that take up considerable space in the body cavity. My impression, for example, near Cape Maguarí, is that females are definitely in the minority. At least, we found on the average of up to four or five males for every female. This comment should be accepted with reservations, however, because I cannot be sure how much of a role chance has played in these encounters, or if humans have not affected the gender ratios. I had the opportunity to convince myself that the latter possibility could occur, mainly by local inhabitants focusing their efforts on catching females. If one slits the belly of a gravid female, the egg mass is immediately evident and often 'boils' out of the wound. A tightly patterned shotgun wound has a similar effect. The locals eagerly and greedily collect the egg masses, which are considered with some justification to be special delicacies. The French traveler, Thébaur, during his upcountry tour, made similar observations — and little has changed today in southern Guahana or on Marajó.

"From September on, the females begin to leave the banks of the large rivers, following the feeder creeks in order to penetrate farther into the lowlands. There they seek sandy places and old dunes where they will hide their eggs in self-constructed burrows, over which they are quite adept at smoothing the surface sands and rendering the nest nearly invisible. A good eye and considerable experience are necessary to find such places, and the locals have developed astounding skills along these lines. Once the females have completed their business, they return to the banks of the rivers.

"The brood consists of 1–1 1/2, at most two dozen eggs, figures that correspond with the numbers of follicles found in the ovaries of females collected in August. I shall use as representative examples, typical in size and shape, two well-developed eggs acquired from the Atlantic Coast of Marajó on 22 September 1886: 1. length 43 mm, breadth 26 1/2 mm, 2. length 43 mm, breadth 26 mm. In form they are broadly elliptical; the white shell is soft, and gives way to the slightest touch. Nevertheless, it is tough, and penetration with a single cut is possible only with a carefully sharpened knife.

"Iguana eggs are, as mentioned previously, delicacies. The extensive, granular yolk is tasty. It never hardens completely when boiled and can be spread like butter. Like those of the Amazon River turtle (*Podocnemis expansa*), they are somewhat hard to digest. Iguana meat also is quite tasty, and it reminds me of that of the local armadillos. It serves as a nice change of pace for river dwellers, and our museum personnel invariably voice their approval if iguana, boiled or grilled, is served. Here in Pará, one sees iguana meat offered for sale by the kilogram in the market or along the streets.

"I don't want to avoid reporting that finding food in our gardens for our wild-caught captive iguanas was, at first, a difficult task, primarily due to the fact that the above-mentioned plants have been displaced by civilizations throughout most of the city and its immediate environs. After considerable searching and experimentation, we were thrilled to find an excellent surrogate in a weed, locally known as 'malvarisco,' which thrives

in fallow fields and orchards. Iguanas readily accepted its leaves, which are similar in size to those of the coltsfoot. Since we have been feeding *Heckeria peltata*, we've not lost a single iguana; just the opposite, as a matter of fact, they are thriving and are, in many instances, downright fat. They also have begun to exhibit signs of becoming tame, moving toward the keeper when he brings them food. We have in a small way endeavored to cultivate this plant, specifically for our iguanas. This is in every way simple, and I am convinced that it would serve well as a crop raised in greenhouses by zoological gardens. It grows rapidly and is easily propagated from seeds. This weed requires no special care, requiring little investment of effort or money.

"*Iguana tuberculata* [= *Iguana iguana*], called 'cameleão' by natives, occurs in great numbers on Mexiana Island, but it is not easy to find because its green color blends well with the tangled bankside vines on which it prefers to perch. These iguanas are shy and, once they take flight, literally shoot across the crowns of trees and bushes with such alacrity that they disappear almost immediately from the view of the hunter and can be traced only by following the tell-tale crackling of small branches broken during their effort to escape. They will ascend the highest forest trees, and I recall one individual I shot down from an astounding height.

"The nest cavities are typically dug at an angle, with an approximately two-foot long passage leading to a slightly enlarged cavity that serves as the egg depository. Because the sand dunes are repeatedly watered during the rainy season, sufficient moisture is retained to keep the sandy burrow from collapsing. Consequently, these sites lend themselves to easy excavation through loose sand, but retain the moisture necessary to sustain the eggs. Although the nest cavities are carefully filled by the females, fresh nests are easy to find, as no effort is made to wipe out the telltale tracks. Because, however, the direction of the sloped passage is not always evident, natives probe the sand and identify the passage or even the egg chamber by the lack of resistance to their efforts."

BIOGRAPHICAL SKETCH

Emílio Augusto Goeldi (1859–1917)

Emílio Goeldi was a Swiss-born Brasilian naturalist. He studied at the University of Naples before earning his doctorate in 1883 at the University of Jena, where he studied under the famous evolutionary biologist, Ernst Haeckel. Goeldi emigrated to Brasil in 1884 to become assistant head of zoology at the Museu Nacional in Rio de Janeiro. He lost that position as a consequence of political changes, but, in 1894, accepted an invitation by the governor of Pará, the large northern state at the mouth of the Amazon River, to become Director of the Museu Paraense. Goeldi served in that capacity until 1904, when he resigned for reasons of health and returned to Switzerland. The museum was subsequently renamed the Museu Paraense Emílio Goeldi in his honor. In 1908, he became Professor of Zoology at the University of Bern, a position he held until his death.

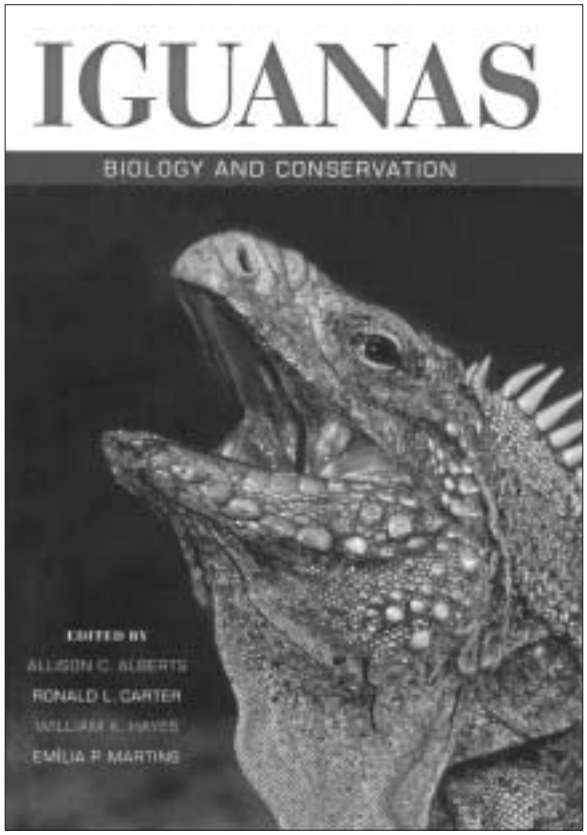
Goeldi published in many areas. His most widely recognized work was *As Aves do Brasil* (*The Birds of Brasil*), published in 1894–1900, followed by an atlas in 1900–1906. Most of his herpetological work dealt with classification and distribution, but he also had a special interest in reproductive biology. Goeldi discovered *Hyla* (now *Flectonotus*) *goeldii* (named by George A. Boulenger in 1895), a frog in which the female carries the eggs attached to her back. Goeldi's major work in herpetology, *Repteis do Brasil*, was completed in 1892–1894, but was never published as a single volume. Much of the content consisted of compilations from the literature, but many of Goeldi's field notes (such as those quoted here by Werner) also were included.

Emílio Goeldi (*photograph courtesy of Kraig Adler*).

Source: Adler, K. 1989. Herpetologists of the past, pp. 5–141. *In* K. Adler (ed.), *Contributions to the History of Herpetology*. Society for the Study of Amphibians and Reptiles, Contributions to Herpetology, Number 5. Ithaca, New York.

BOOK REVIEWS

Alberts, A. C., R. L. Carter, W. K. Hayes and E. P. Martins (eds.). 2004. *Iguanas: Biology and Conservation*. University of California Press, Berkeley. xvi + 356 pp. Cloth, $65.00.



Since its publication in 1982, *Iguanas of the World: Their Behavior, Ecology and Conservation* (G.M. Burghardt and A.S. Rand, eds. Noyes, Publ. Park Ridge, New Jersey) has served as a primary reference for anyone interested in iguanas. The 31 authors represented in that volume summarized what was known about the biology of most genera in the subfamily Iguaninae of the family Iguanidae as it was then understood. Intended primarily for the professional biologist, the book predated the explosion of interest in iguanas brought about by the relatively recent rise in the popularity of Green Iguanas in the pet trade, and of breeder interest in some of the highly endangered West Indian Rock Iguanas (*Cyclura*). It also predated the discovery of the amazing shrinking Marine Iguanas of the Galápagos Islands, the rediscovery of the "extinct" Jamaican Rock Iguana (*Cyclura collei*), and extensive research in the field and on captive colonies of many other iguanines. Consequently, I opened the literary heir-apparent to Burghardt and Rand's landmark volume with considerable anticipation.

The new book evolved from a symposium sponsored by the Herpetologists' League in 1997. With the exception of Gordon Burghardt, none of the authors who were represented in the Burghardt and Rand volume contributed to this one, but the general themes are essentially the same: evolutionary diversity, behavior and ecology, and conservation of iguanas. Following an introductory and largely autobiographical chapter by Burghardt, a section of the book is devoted to each of these themes.

The five chapters of Part I are devoted to diversity. The first provides a useful discussion of the evolution and relationships of iguanas, and includes a checklist of species. The taxonomy of lizards in the family Iguanidae has been controversial. Pending resolution of that controversy, the author adopts a concept of Iguanidae attributable to Frost and Etheridge (1989. *University of Kansas Museum of Natural History Miscellaneous Publication* no. 81). That concept recognizes the following living genera: *Amblyrhynchus* (Galapagos Marine Iguana, 1 species), *Brachylophus* (Fijian Iguanas, 2 species), *Conolophus* (Galapagos Land Iguanas, 2 species), *Ctenosaura* (Neotropical Spiny-tailed Iguanas, 17 species), *Cyclura* (West Indian Rock Iguanas, 7 species), *Dipsosaurus* (Desert Iguanas, 2 species), *Iguana* (Green Iguanas, 2 species), and *Sauromalus* (Chuckwallas, 5 species). Two Malagasy genera, *Oplurus* and *Chalarodon*, are excluded, although, interestingly, the editors include them in the preface, but make no mention of them in the introductions to each of the three main sections of the book. Following the chapter on evolution and relationships, the next three chapters are based on genetic data: the contributions of genetic research to the conservation of Caribbean iguanas, the genetic structure of the Turks and Caicos Rock Iguana (*C. carinata*) and its importance to the conservation of the species, and the evolution of Galapagos iguanas as revealed by molecular data. The last chapter in the section concerns sodium and potassium secretion by means of salt glands. More comparative than other chapters, it makes comparisons with species in other families of lizards, and specifically addresses the function and importance of salt glands and their association with herbivory and marine diets.

The titles of the first two chapters in the section on behavior and ecology suggest that they will be broadly comparative, but they actually discuss only the results of research on *C. carinata* in the Turks & Caicos Islands. The first documents the occurrence of appeasement displays and the second compares the display behavior and morphology among populations and relates these to island area and to vegetation heights and densities. The next five chapters discuss laboratory and field studies of sexually dimorphic antipredator behavior in Green Iguanas, determinants of mating success by male Galapagos Marine Iguanas (*Amblyrhynchus cristatus*) in leks (defined as "clusters of territorial males"), environmental determinants of body size in Marine Iguanas (the "shrinking iguanas" mentioned above), Chuckwallas (*Sauromalus obesus*), and Desert Iguanas (*Dipsosaurus dorsalis*), and factors affecting the long-term growth of the Allen's Cays Rock Iguana (*C. cychlura inornata*). The latter chapter also considers the effects of human visitation.

The final section consists of seven chapters devoted to conservation. Topics include translocation strategies, headstarting, habitat restoration, the role of zoos, and the potential impact of ecotourism. All of these chapters are based on studies conducted in the West Indies. Despite this limitation, this section of the

book should attract the broadest readership because all of the topics included are applicable to reptiles and animals other than iguanid lizards.

The book is well-produced, with a solid binding, tight editing, and a general absence of typographical errors. The tables and graphical illustrations are uniformly unambiguous and informative, and the black and white photographs are clearly reproduced. A small complaint: reproducing some of the latter in color would have been nice. Although the volume had its origins in a symposium held over six years prior to publication, the chapters are remarkably up-to-date, and this distinguishes it from many other symposium volumes that have seen long delays between the oral presentations and publication. Of the 906 references in the Literature Cited, 218 (24%) were published in 1998 or later, the most recent in 2003. In fact, for students of iguanid biology, the Literature Cited section will be a treasure.

I have only one major complaint about the book: the title, *Iguanas: Biology and Conservation,* is misleading. The bulk of the book (and the entire section on conservation) concerns West Indian iguanas, primarily a few species of *Cyclura*. Fijian Iguanas are barely mentioned, only one (of five) species of Chuckwallas is discussed in detail, and none of the 17 species of Spiny-tailed Iguanas are addressed beyond their inclusion in the checklist. This may reflect the origins of the book in a symposium held in 1997, when Mexican biologists were just beginning to study various aspects of the biology of Spiny-tailed Iguanas, or it may reflect the interests of the editors, all of whom have emphasized West Indian Rock Iguanas in their own research, or both. Regardless, the book would have benefited from contributions on, at least, the conservation status of a broader range of iguanid genera and species. As it stands, subtitling the book "*Biology and Conservation with Emphasis on the West Indies and the Galápagos*" might have been appropriate. In this one respect, the new book does not match its predecessor.

Like the Burghardt and Rand volume, this book is intended primarily for the professional biologist who studies lizards, but it will be of interest to others as well. Private breeders of iguanas will find much useful information in the chapters on ecology and behavior. Conservation biologists and, indeed, anyone with an interest in these fascinating lizards will find the chapters on conservation interesting and informative. Hopefully, in a decade or so, a third volume in this budding series will more fully acknowledge the diversity within the family Iguanidae.

Arthur C. Echternacht
University of Tennessee

Iguanas in Wonderland: The Depiction of Reptiles in Children's Literature

Johnston, Tony. 1995. *The Iguana Brothers: A Tale of Two Lizards*. Illustrated by Mark Teague. Blue Sky Press, New York, New York. 30 pp. Cloth, $15.95.
Laden, Nina. 1995. *Private I. Guana: The Case of the Missing Chameleon*. Illustrated by the author. Chronicle Books, San Francisco, California. 26 pp. Softcover, $5.95.
Krailing, Tessa. 1998. *The Pet Sitter's Club 8: Where's Iggy*. Illustrated by Jan Lewis. Barron's Educational Series, Inc., Hauppauge, New York. 94 pp. Softcover, $3.95.
Snicket, Lemony. 1999. *A Series of Unfortunate Events, Book 2: The Reptile Room*. Illustrated by Brett Helquist. HarperCollins Publishers Inc., New York, New York. 191 pp. Cloth, $10.99.
Wiebe, Trina. 2000. *Abby and Tess Pet sitters: Lizards Don't Wear Lip Gloss*. Illustrated by Marisol Sarrazin. Lobster Press, Montreal, Quebec. 91 pp. Softcover, $5.95.

As both a student and a fan of children's literature, I have long been fascinated by its ability to shape the imagination of readers young and old. I recently had the opportunity to spend some time in the children's book section of a well-stocked bookstore, where I came across a number of reptile-related works of fiction, which provide some very different representations of their animal subjects.

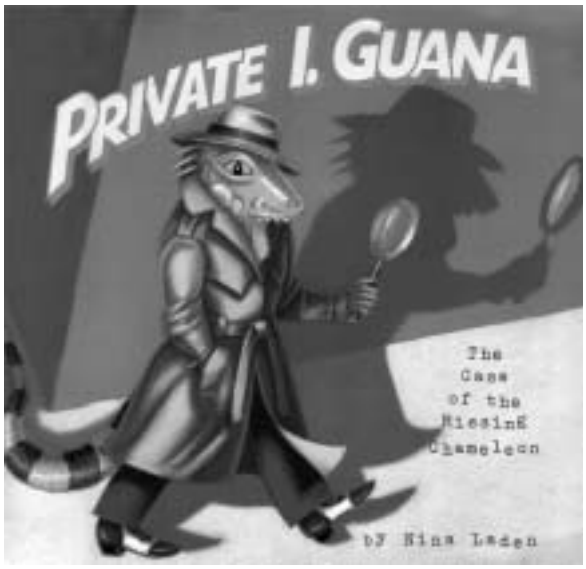
Two of these books were quite similar, featuring groups of children who are "pet-sitting" reptiles that escape from their enclosures. In *Where's Iggy?*, published in the UK, the iguana named in the title seems well cared for, housed in a large terrarium in a greenhouse and outfitted with a heat lamp, a climbing branch, and a water tray. However, the owner of the lizard instructs the children that Iggy "doesn't eat a lot, mainly cabbage leaves and bananas … and crickets." So, where's Iggy? His loca-

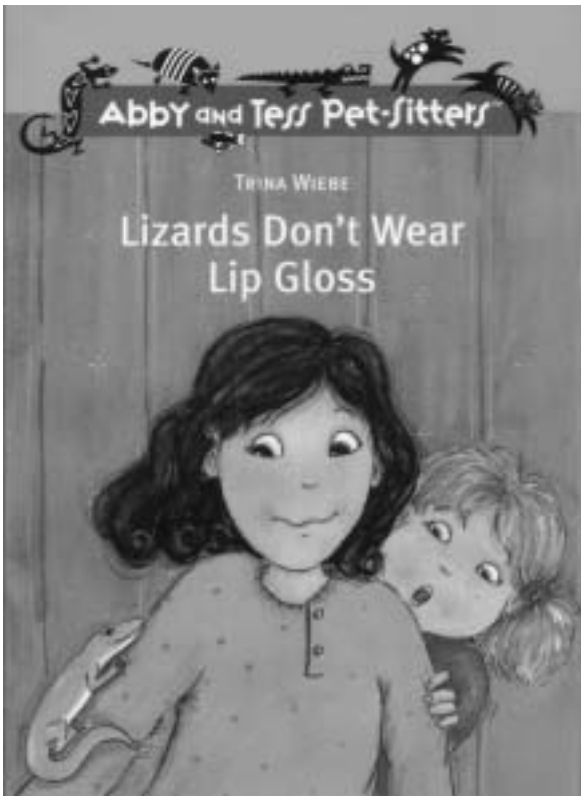
tion seems irrelevant, since the thyroid problems, calcium-phosphorus imbalance, and liver and kidney diseases caused by his poor diet and lack of UV light are sure to lead to an early demise.

The reptile featured in *Lizards Don't Wear Lip Gloss*, a Canadian publication, is a Green Anole, whose husbandry is much more appropriate. Angus, the anole, lives in a well-appointed vivarium, with a heat lamp and a fluorescent UV tube, and the children are clearly informed that "Angus needs the vitamins the UV rays provide." The statement, "all lizards eat a diet that consists mainly of live insects," neglects herbivores, but at least the setup and diet described for Angus's crickets is suitable.

The plots of these books center on lizards escaping from their enclosures while the children struggle with crickets. In both cases, subsequent to the involvement of assorted rescue professionals, the animals are found perched on objects close to their habitats. Given the frequency with which pet owners need to be retrained in proper reptile care, I was disappointed at the incorrect and incomplete animal care information provided in these realistic stories.

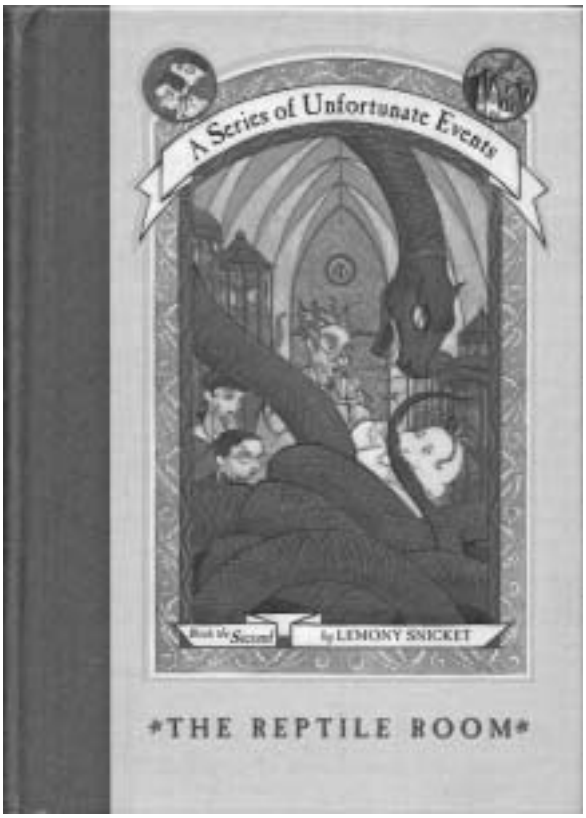
Another pair of books features iguanas as primary characters. *Private I. Guana: The Case of the Missing Chameleon*, is a tongue-in-cheek tale of a hard-boiled detective hired by Lizzy, a chameleon, to find her missing husband, Leon. After searching "over fields, under rocks and up trees," Mr. Guana ends up at the Lizard Lounge, "a slimy place where only the most cold-blooded reptiles hang out." As it turns out, Leon has been working in drag at the Lizard Lounge, singing as "Camille" with the "Gila Girls," because he needed to express his "wild side." The illustrations by the author are hilarious and worth the price of the book. My personal favorite is of I. Guana at the Lizard Lounge with Sally(mander) the waitress, who, naturally, is asked, "what's a nice amphibian like you doing in a place like this?"

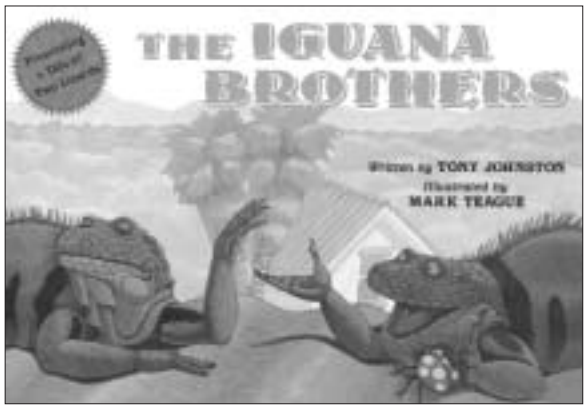


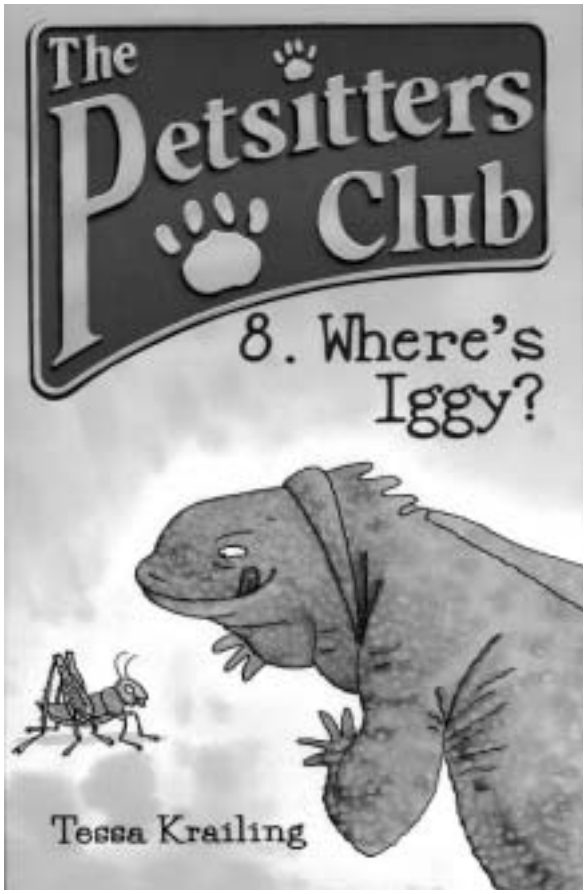


The Iguana Brothers: A Tale of Two Lizards features brothers Dom and Tom as they contemplate the philosophy of life. Dom is convinced by Tom to give up eating bugs because they will make him thin and pale and cause his tail to drop off. They further reject pigs and snakes and finally settle on a diet of flowers. Dom and Tom convince themselves that they are as mighty as dinosaurs, but end up rejecting rule of the stars for their own earthly kingdom and each other's friendship. A simple but positive story line, brought to life by Mark Teague's delightful illustrations, I was pleased to learn that the iguana brother's tale is to be made into an animated film.

Although no iguanas appear in the story, my favorite among the books in this review is *A Series of Unfortunate Events, Book 2: The Reptile Room*, in which a very endearing herpetologist is a major character. The ten books that have so far been published in the series involve three orphan children, who are sent to live with assorted guardians in increasingly more appalling situations while they try to solve the mystery surrounding their parents' untimely deaths. The redundantly named Dr. Montgomery Montgomery is a famous herpetologist, who loves to make coconut cream cake. The Reptile Room itself contains a fantastic collection of animals, including the Alaskan Cow Lizard, a long green creature that produces delicious milk, the Dissonant Toad, the Irascible Python, and the Virginian Wolfsnake, which must "never under any circumstances [be allowed] near a typewriter." Despite his warning to the children that "no harm will come to them" in the Reptile Room, "if [they] take the time to learn the facts," the unfortunate scientist is murdered by arch-villain, Count Olaf, who injects him with venom from the Mamba du Mal.



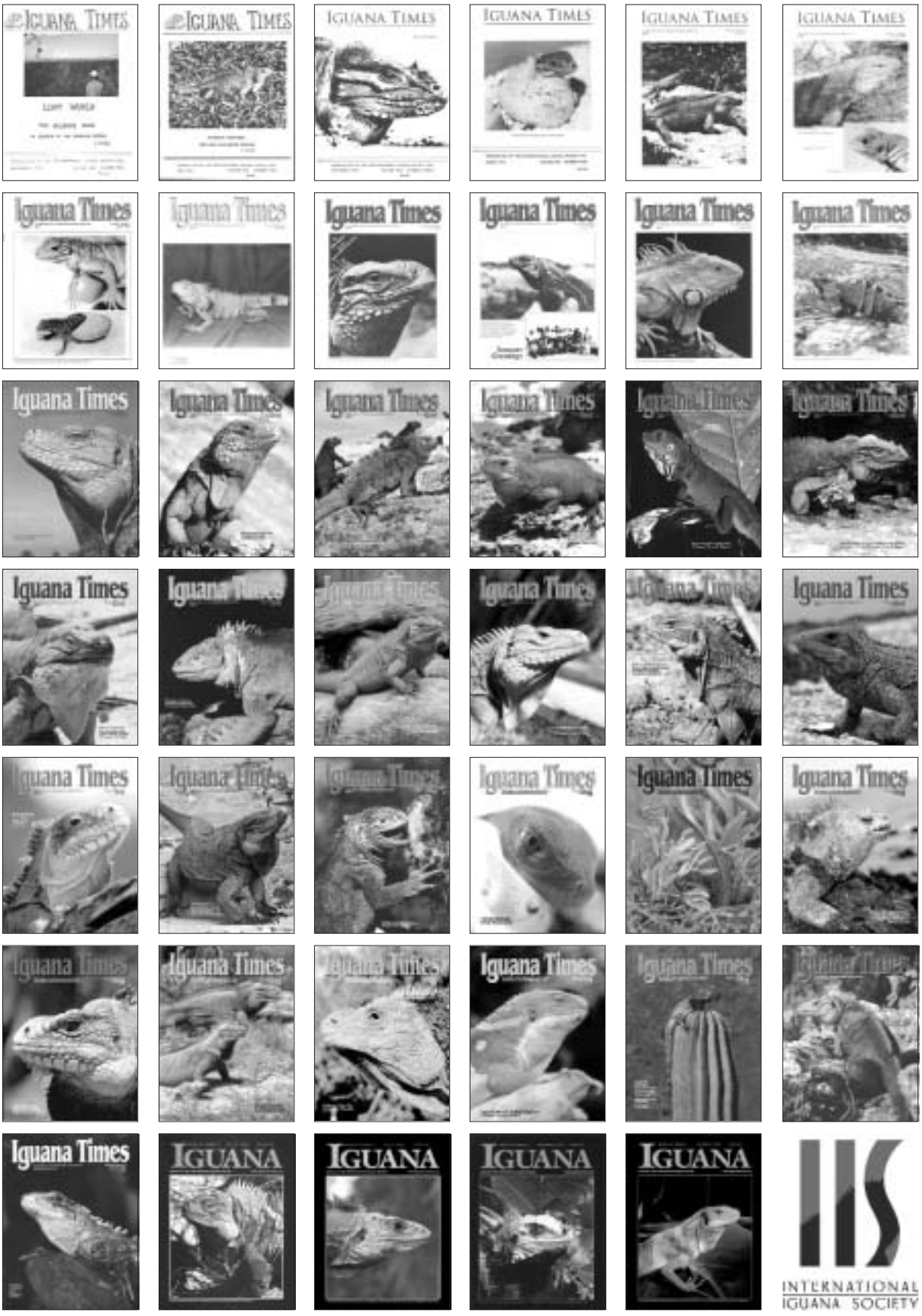




The series is quite clever and features humorous wordplay and some very adult literary references as well as an intriguing mystery. The latter actually involves the true identity of the author, Lemony Snicket, and his relationship to the children in the novels. Starting with "the Reptile Room," I found myself charmed by the characters and their misfortunes, and proceeded through the other nine volumes in the series, all of which are appealingly illustrated by Brett Helquist. The mystery of what became of Uncle Monty's reptile collection has yet to be solved, and I eagerly await the next installment. Like any of the best children's literature, I can certainly recommend this series to readers of any age.

Private I. Guana orders a plate of fried grasshoppers at the Lizard Lounge, however, he wears a trench coat and two-toned patent leather shoes, and is clearly not a real iguana. I feel much more inclined to forgive Ms. Laden for her portrayal than I do Ms. Krailing, whose "Iggy" is depicted as a real pet. Sadly, supposedly legitimate iguana care manuals are still advocating dog food and monkey chow for pet iguanas, but no legitimate excuse exists for perpetuating harmful information. Bugs, as Dom tells Tom, will indeed leave an iguana "thin and pale." My highest recommendation goes to the mysterious Mr. Snicket. Although Snicket's reptiles are fairly preposterous, his herpetologist character embodies noble virtues: a good education, good manners, humor, and fondness and respect for animals.

AJ Gutman


IGUANA TIMES
Iguana Times
IGUANA
INTERNATIONAL
IGUANA SOCIETY

Indices to the *Iguana Times* (1990–2002) and *Iguana* (2003): Volumes 1–10

Compiled by Robert Powell

Avila University, Kansas City, Missouri

Because the *Iguana Times* and *IGUANA* have provided valuable information regarding iguana conservation, husbandry, natural history, and systematics over the years, and because a ready reference to those resources has been lacking, the editors are pleased to include these indices to topics covered, species addressed, and authors who have contributed to the first ten volumes of the *Journal of the International Iguana Society.* Each entry is listed by volume, number, and pagination.

Index to Topics

Index to Species

Index to Authors

IGUANA NEWSBRIEFS

The IIS at the ISG Meeting in the Turks & Caicos Islands

Joe Burgess, IIS Vice-president, represented the Society at the 2003 ISG Meeting in the Turks & Caicos Islands (see also the article on p. 27). He gave a short PowerPoint presentation highlighting IIS activities and projects over the past year and passed around the current issue of *IGUANA*. Both the presentation and the journal were well-received, with many commenting on improvements in the appearance and content of the journal.

The presentation featured the IIS participation in shows in Daytona (see Editors' Remarks, *IGUANA* 10(3), p. 96) and Seattle (see Iguana Newsbriefs, *IGUANA* 10(4), p. 155), where members promoted education and increased awareness regarding conservation and conservation specifically of iguanas, announced that the IIS would host the auction in Daytona in 2005, and reported fund raising efforts to support conservation through the sale of posters, t-shirts, mouse pads, and other products. A recent IIS donation to the Hope Zoo (Jamaica) renovation of the captive breeding and headstart facility for Jamaican Iguanas (*Cyclura collei*) is an example of the work supported.

The report on the IIS meeting on Utila and the problems facing *Ctenosaura bakeri* (see *Iguana Times* 9(3)) led to *C. bakeri* being added to the list of ISG funding priorities; with nesting beach acquisition and education as the main areas of concern.

IIS Vice-president Joe Burgess making a PowerPoint presentation at the 2003 ISG Meeting in the Turks & Caicos Islands.

Ctenosaura similis is well-established and widely distributed in Florida (see *IGUANA* 10(4):111-118). *Photograph by Josiah H. Townsend.*

Introduced Ctenosaurs on Florida island damaging ecosystem?

U.S. Fish & Wildlife Service biologist Dennis Giardina has been collecting Spiny-tailed Iguanas (*Ctenosaura similis*) for investigations that will determine whether this non-native species has been impinging on native wildlife on Keewaydin Island, off the eastern coast of Florida. Recently captured and killed iguanas, along with other frozen specimens, are being sent to a laboratory at the University of Florida, Gainesville, where herpetologist Kenneth Krysko will be studying their stomach contents. At issue is whether these large lizards are eating the eggs or young of protected species of shore birds, sea turtles, and Gopher Tortoises. The origin of the Keewaydin Island iguana population is probably either a deliberate or accidental release. Releasing non-native species into the wild in Florida is a first-degree misdemeanor punishable by up to one year in jail and a $1000 fine.

Source: Naples Daily News

Activists Call for a Reptile Museum to Close[1]

Patrick Healy
New York Times — 27 November 2003

HICKSVILLE, N.Y., Nov. 26 — Animal activists said on Wednesday that they were outraged by a history of problems at the Long Island Reptile Museum and called for the gallery of snakes, lizards, and turtles to be shut down.

The activists, who have visited the museum and taken some of its animals for rehabilitation, called conditions there the most deplorable they had ever seen. During a visit by the activists in the spring, they said, the reptiles were emaciated and dehydrated, some were covered with red and black mites, and some dead animals remained on display.

In addition, they said snakes and large lizards had escaped from their cages and were crawling around the rafters, a potential threat to visitors.

The museum's director, Steven Kates, while acknowledging that the museum had its flaws, said conditions had improved markedly in the last few months. But the reptile rescuers, who collected dozens of ailing animals from the museum (with Mr. Kates's permission), insisted the animals there were still at risk.

"I don't know what the place is still doing open," said Rusty Gilman, a reptile rescuer who said she had taken 18 animals from the museum for rehabilitation.

The Nassau County Society for the Prevention of Cruelty to Animals has heard the complaints and is investigating the museum, which houses more than 200 snakes, lizards, and other reptiles.

"That has been a major problem for some time," said Harry Babb, deputy chief of the Nassau SPCA's Division of Law Enforcement. "We've had vets up there and experts from the animal world. They've been trying to meet the requirements that we've set for them, and it's been slow going."

This is not the first time the museum and Mr. Kates have run afoul of advocacy groups and the law. In April 2002, Mr. Kates and another man were charged with cruelty to animals after officials received a complaint that a lizard at the museum had had its jaw wired shut. In 1998, the Town of Oyster Bay took the museum to court, saying it was operating without the proper licenses.

Mr. Kates, who wrote the Encyclopedia of Cockatoos and calls his adversaries haters, opened the reptile

[1] Reprinted with permission.

Stephen Kates of the beleaguered Long Island Reptile Museum holds Digger, a Cuban Iguana.

museum in July 1995. The museum has slightly fewer than 300 spaces for animals, and soon after Mr. Kates began accepting donated animals from the public, he found himself overwhelmed.

People would drive by the museum and hurl their sick and unwanted pets — ranging from reptiles to guinea pigs to rabbits — from their cars and onto Mr. Kates's doorstep, he said in an interview Wednesday afternoon. He said he found himself with 60 boa constrictors and 50 iguanas, though he only had room for a few of each.

"I thought I could handle it, and I really couldn't," he said.

Mr. Kates said he had hired one of his fiercest critics to improve conditions at the museum. That critic, Lori Green, said she had set up a rehabilitation program for the animals and spent time training the staff, which she described as dedicated and caring.

On Wednesday, the snakes, turtles, and lizards seemed content enough with their heat lamps and plexiglass-encased lives at the museum. They could be seen snapping at goldfish, eyeing each other for mating, and doing what reptiles do best, which is to say, not much.

"I maintain order there," Ms. Green said. "The place is what it is, but it's a major improvement."

Educational Signs for St. Eustatius

In light of the precarious status of the Lesser Antillean Iguana (*Iguana delicatissima*) on St. Eustatius (see *Iguana Times* 6(3):51–56 and 8(1):3–6 and abstracts of reports at this year's ISG meeting, p. 37), the IIS, in cooperation with the St. Eustatius National Parks Foundation (STENAPA), has produced educational signs that are to be posted at STENAPA headquarters, the botanical garden, trail heads, the airport, the tourist bureau, and local hotels and dive shops. The iguana graphic was adapted from a John Binns photograph by Joel Friesch.

Donations Assist with Conservation Work

The IIS has received a donation of $3000 from Mr. Donald Tuttle and the Tuttle Charitable Trust of Beaux Arts, Washington. This generous gift will assist in our efforts to support *Cyclura cychlura figginsi* in the Exuma Islands, *Cyclura lewisi* on Grand Cayman Island, and *Ctenosaura bakeri* on Utila, Honduras, among others.

At the urging of 16-year old iguana advocate, Jayna Fowler, the Pacific Northwest Herpetological Society has donated $500 towards the Utila Iguana nesting property fund.

An example of our cage products is illustrated in the husbandry article, which begins on p. 39.

Erratum: On p. 150, *IGUANA* 10(4), the caption to the photo of Franz Werner erroneously stated that he was holding a *Boa constrictor*, when, in fact, he was holding a Reticulated Python (*Python reticulatus*).

INTERNATIONAL IGUANA FOUNDATION

12 December 2003

International Iguana Society
A.J. Gutman, Secretary
133 Steele Road
W. Hartford, CT 06119

Dear AJ:

On behalf of the Board of Directors of the International Iguana Foundation we want to thank the IIS for their generous contribution to the Hope Zoo iguana management program for *Cyclura collei*. We have been frustrated for some time now that, despite a very successful headstarting program, the existing facilities for the adult breeding-sized iguanas were not conducive for successful captive reproduction. Over the years we have tried tweaking the enclosures by various methods but problems persisted, primarily attributable to improper nesting substrate and inadequate basking and thermoregulatory opportunities (too much shade).

In response to this situation the IIF sent Jeff Lemm to Kingston to conduct a thorough on site evaluation of the various iguana facilities, and to make recommendations to improve the program. Jeff's report indicated a need for a near-complete overhaul of the three large facilities for adult iguanas. Enhancements will include tree trimming to permit better sun penetration, provision of better basking areas, removal of large rocks that prevent eggs from being retrieved, a new and dependable reptile egg incubator, and most importantly adding new soil substrate.

The costs of all these improvements came to over $10,000, which is more than the IIF can currently allocate given our other commitments to iguana conservation in Anegada, Grand Cayman, Dominican Republic, Jamaica and St Lucia. So it is with extreme enthusiasm that I accept IJS's $2,000donation towards this worthy project. Please convey this message to your Board, and let them know that the IIF genuinely looks forward to a productive working relationship with the IIS in the future. We need to expand our collaborations and partnerships, and I believe this officially signals the beginning of that process. Best of luck in all of your endeavors.

Sincerely,

Rick Hudson

Rick Hudson
IIF Program Officer
Conservation Biologist
Fort Worth Zoo

Editors' Remarks

Long-time readers of IGUANA will have noticed regularly appearing features in recent issues addressing husbandry, profiles of notable "iguana persons," historical perspectives, biographical sketches, book reviews, and, less regularly, species profiles about non-iguanid reptiles or amphibians found in areas where iguanas live. The husbandry feature serves an obvious purpose, namely to facilitate proper care of iguanas in captivity. Because many of our readers maintain captive iguanas and many others became involved initially in iguana conservation or research as a consequence of interacting with captive iguanas, this feature is devoted to the core of our reading audience. Note that husbandry features, although often focused on a particular type of iguana, present information that often is widely applicable to many species. However, some caution is advised. For example, some important differences apply to the care of Green Iguanas (*Iguana iguana*) and Black or Spiny-tailed Iguanas (*Ctenosaura* spp.) or even to different species of ctenosaurs (see Husbandry, p. 39).

The purpose for including historical perspectives may be less evident. George Santayana, a notable philosopher, coined the phrase, "Those who do not learn from history are doomed to repeat it." Many of the historical features presented so far date to the turn of the 20th Century and are notable in that the scientists often expressed disdain for iguanas, with the notable exception of their gustatory qualities. That the most enlightened minds of that day were unable to anticipate the inevitable impact that such attitudes would have on future generations of iguanas speaks eloquently to the failure to anticipate the dramatic growth of the human population and its generally negative effects on natural habitats and the wildlife that inhabits them. Sadly, such attitudes remain prevalent in the 21st Century, especially among policy-makers, whose views rarely extend beyond the next election or quarterly statement. If Santayana's prediction holds, wildlife populations will continue to disappear at alarming rates — and only education and the resultant awareness can evoke the necessary changes to curb this distressing trend. Future perspectives will continue to illustrate this recurring theme, but also will provide insights into the research that has caused at least some scientists and other concerned citizens to call for reforms.

In the next issue, we'll discuss profiles of individuals who have made important contributions to our knowledge of iguanas and of species who co-exist with iguanas in complex biotic communities.

Bob Powell, AJ Gutman, and John Binns

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
Foreign Organizational Membership* $45.00
(*receives double copies of *Iguana*)

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

JOIN ON-LINE AT: www.IguanaSociety.org

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 are entitled to five copies of the issue in which their article appears.

Advertising Policy of *IGUANA*

We advertise only non-living products (except feeder insects). All products have been examined and been found to be high quality and fairly priced. Contact Sandy Binns, Advertising Director, at sandy@cyclura.com or 3010 Magnum Drive, San Jose, CA 95135.

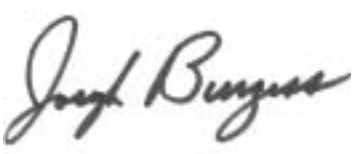
LETTER FROM THE VICE-PRESIDENT

Greetings, Friends! Our President normally handles this column, but he's currently in the field. Since I was given this opportunity (as Vice-President), I thought I would tell you a little about myself and about how I became involved with (iguana) conservation. Even as a youngster, I was interested in herpetology, especially lizards, and I have run the gamut of keeping all the various types of herps. As I got older, I started concentrating on specific lizard families: geckos, chameleons, and iguanids, with *Anolis* and true iguanas as favorites. I began traveling regularly to the Caribbean and, to a lesser extent, Central and South America in search of the 350+ species of anoles.

Although most hobbyists consider anoles to be a beginner's lizard or, even worse, snake food, they are usually not aware of the specialization and evolution of this varied group. Anoles as a group are the most intensely studied reptiles in the world, and they have served as models for a number of ecological and evolutionary studies.

In my travels in search of anoles, I inevitably encountered some of the species of *Cyclura*, *Iguana*, and *Ctenosaura*. My first encounter, and one of the most memorable, was on the Naval Base at Guantanamo Bay, Cuba. I was walking along the edge of a scrub thicket looking (of course) for anoles and Curlytail Lizards (*Leiocephalus*). At the time, I was a young man (19–20) and wasn't fully aware of the status or abundance of Cuban Iguanas on the base. I knew that they were protected and rare, so I didn't expect to see any in the limited time available to me. However, as I made my way along the path, out of the corner of my eye, I noticed movement, large movement. I turned to see a huge male *Cyclura nubila* three meters away bobbing his head at me. My emotions were a mix of excitement, veneration, amazement, and surprisingly, for just a moment, FEAR, as I observed this remarkable creature, who seemed larger than life. The experience was profoundly affecting. Needless to say, I was hooked.

Fifteen years later, seeing an iguana in its natural habitat still evokes the same emotions (except fear). After that encounter, I felt I needed to learn more about these magnificent lizards, and to find out what I personally could do to help reverse the rapid decline in their numbers. Since then, I have met many wonderful people dedicated to iguanas, and have been privileged to participate in several conservation projects, most recently a population survey of *Cyclura pinguis* on Anegada. This spring, I will assist in the Turks & Caicos Islands with *C. carinata* translocation and research. I hope that, in some small way, my work will help assure that these beautiful creatures will continue to inspire awe and reverence for many years to come.



Joe Burgess

Joe Burgess with an *Anolis luteogularis. Photograph by Dorothy Burgess.*

The IIS contingent in Seattle: Izzy, John Binns, Joe Wasilewski, and Joe Burgess (left to right).

Surveys on Anegada were hot work: Joe Burgess (left), Sallie Davie (center), and Roberto Maria (right) take a short break. *Photograph by John Binns.*

Adult male Ricord's Iguana (*Cyclura ricordii*) from Isla Cabritos, Dominican Republic (story on p. 9). *Photograph by David Nieves.*