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IGUANA

CONSERVATION, NATURAL HISTORY, AND HUSBANDRY OF REPTILES

International Reptile Conservation Foundation

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GLENN MITCHELL

Anegada or Stout Iguana (*Cyclura pinguis*) (see article on p. 78).



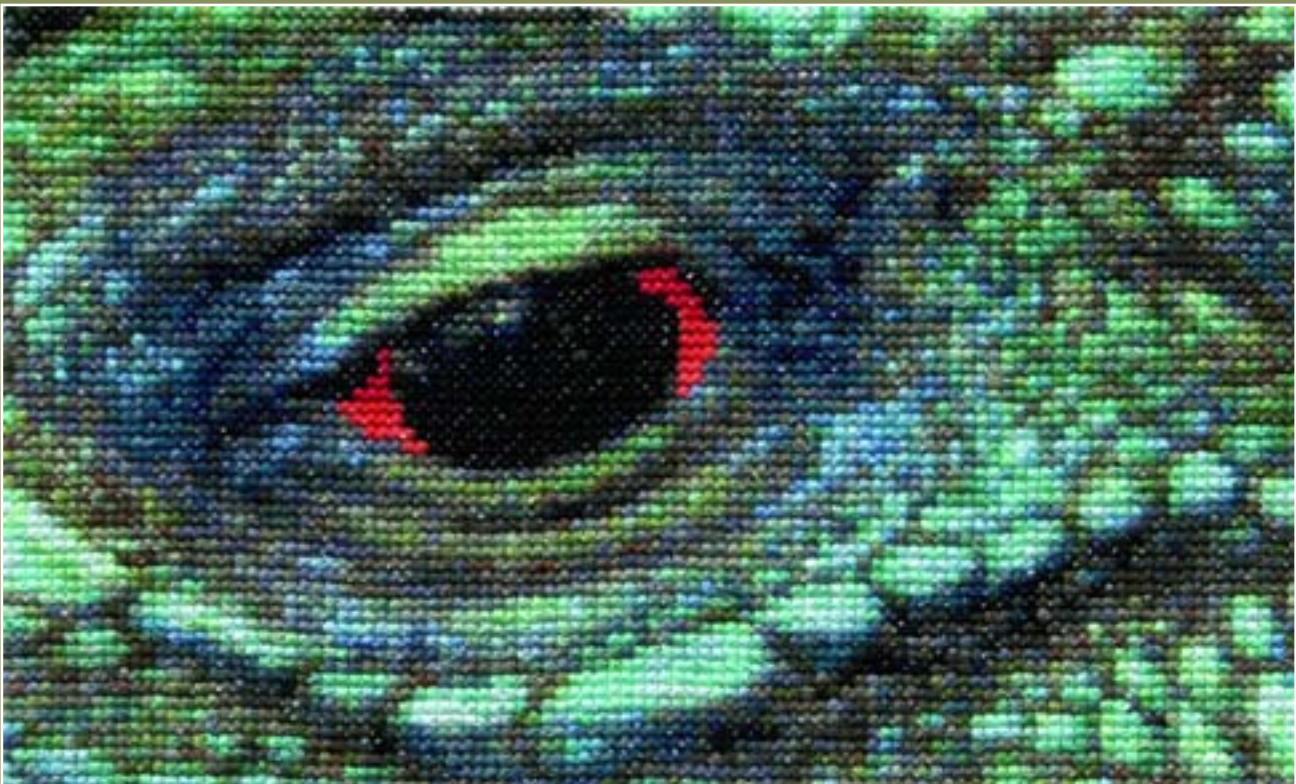
JOHN BINNIS

A subadult Stout Iguana (*Cyclura pinguis*) awaiting release at the head-starting facility on Anegada (see article on p. 78).



RICHARD SANDAK

Timber Rattlesnakes (*Crotalus horridus*) reach the northernmost extent of their range on the bluff prairies in Wisconsin (see article on p. 90).



This cross-stitch was created by Anne Fraser of Calgary, Alberta from a photograph of Carley, a Blue Iguana (*Cyclura lewisi*) at the Captive Breeding Facility on Grand Cayman. The piece, which measures 6.8 x 4.2 inches, uses 6,100 stitches in 52 colors and took 180 hours to complete. It will be auctioned by the IRCF at the Daytona International Reptile Breeder's Expo on 20 August 2005. Profits from the auction will benefit conservation projects for West Indian Rock Iguanas in the genus *Cyclura*.



ROBERT POWELL

Red-bellied or Black Racers (*Alsophis rufiventris*) remain abundant on mongoose-free Saba and St. Eustatius, but have been extirpated on St. Christopher and Nevis (see article on p. 62).



ROBERT POWELL

Spiny-tailed Iguanas (*Ctenosaura similis*) are abundant in archaeological zones on the Yucatán Peninsula. This individual is on the wall around the Mayan city of Tulum (see article on p. 112).



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JOHN BINNS

A large adult male Rhinoceros Iguana (*Cyclura cornuta*) “escorts” a rival from his territory in the large enclosure at ZooDom, Dominican Republic.



JOHN S. PARMERLEE, JR.

A Red-bellied Racer (*Alsophis rufiventris*) basking on the rim of The Quill, a dormant volcano on St. Eustatius. These snakes are abundant here, but have been extirpated elsewhere on the St. Christopher Bank, where the mongoose has become established.

Conservation Status of Lesser Antillean Reptiles

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Abstract.—Island populations of terrestrial animals often are vulnerable to human-mediated changes to their environments. Many insular endemics have become extinct, had populations extirpated, or are in various stages of decline. Herein we address the conservation status of terrestrial reptiles in the Lesser Antilles. Although many species in the region are ecological generalists and have adapted to the presence of humans, nearly half of the reptilian species native to the archipelago have suffered as a consequence of human alterations of their habitats or introductions of alien predators and competitors, often aggravated by catastrophic natural events such as hurricanes. Particularly vulnerable are species that are terrestrial and diurnally active. Although many of the listed factors have contributed to the decline or elimination of particular species from individual islands, we contend that the introduction of the mongoose is the single event most responsible for the extirpations and declines of many Lesser Antillean reptiles.

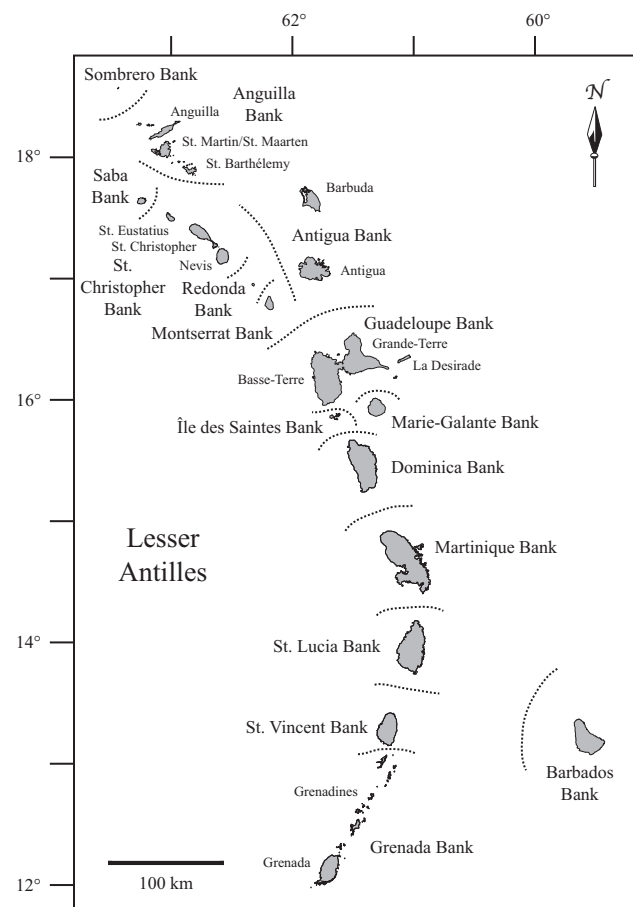
Key Words: Conservation, Reptiles, Lesser Antilles

Insular populations of terrestrial animals often suffer as a consequence of alterations to their habitats by human agency (e.g., Fosberg 1983, Case et al. 1992). Habitat specialists and endemic species that have evolved in the absence of efficient mainland predators and competitors are particularly vulnerable (e.g., Case et al. 1992). Faunas of isolated oceanic islands are represented disproportionately on lists of threatened or endangered species (e.g., 327 of 1264 or over 25% of species included on the list of U.S. endangered species are from Hawaii (http://ecos.fws.gov/tess_public/TESSUmap?status=listed)).

Declines in amphibian populations throughout the world have been documented in recent years (e.g., IUCN et al. 2004), but comparable surveys of reptilian species have yet to be implemented. Although a few species and even some genera (e.g., West Indian Rock Iguanas in the genus *Cyclura*; e.g., Alberts 2000, Alberts et al. 2004) have been the focus of intensive conservation efforts, populations of many more species, a large proportion of them found only on small islands, are in various stages of decline, and some are in imminent danger of extinction, often with little recognition by the public or even professional conservation biologists.

Herein we address these concerns for reptiles inhabiting the Lesser Antilles, an archipelago of oceanic islands on which reptiles are frequently the most abundant and obvious naturally occurring vertebrates. General surveys of the herpetofauna include Schwartz and Thomas (1975), Schwartz and Henderson (1988, 1991), and Censky and Kaiser (1999), but the only previous systematic overview of conservation needs is that of Corke (1992), and that was restricted to the Windward Islands. Although many Lesser Antillean species are ecological generalists and some thrive in altered habitats (e.g., Henderson and Powell 1999, 2001), populations of many others are declining at alarming rates. Some recent extirpations and even some extinctions have been documented, with a majority of both

attributable to human agency. Based on our own work in the region and surveys of the literature, we contend that at least 37 of 81 (45.7%) presumably native terrestrial reptilian species



Map of the Lesser Antilles, showing major islands and island banks.



JOHN BINNS

inhabiting these islands have been affected negatively in some substantive way by human activities (Table 1). These include species that have become extinct since European arrival and species (e.g., lizards in the genera *Ameiva* or *Iguana* and snakes in the genus *Alsophis*) with at least some populations that have been extirpated or drastically reduced in numbers.

Below is a summary of the terrestrial reptilian species found in the region, with particular emphasis on those that we believe warrant further attention by governmental and non-governmental, local and international conservation agencies. For those species that are most severely threatened, we provide an overview of the distribution, note any protective measures that currently exist, and provide tentative identification of the principal causative agents responsible for declining population numbers and preliminary recommendations for protection.

Turtles (Testudines)

Tortoises (Testudinidae) in the Lesser Antilles are represented by an amalgam of populations that are apparently natural (e.g., fossil remains of *Geochelone sombreroensis* from Sombrero and *G. carbonaria* from Anguilla; Auffenberg 1967, Lazell 1993, respectively) and populations of *G. carbonaria* on several islands (e.g., Schwartz and Henderson 1991) or *G. denticulata* on Guadeloupe (Breuil 2002) that may be natural, introduced by Amerindians, established recently as a consequence of escaped pets, or combinations thereof (e.g., Censky 1988). Red-footed Tortoise (*Geochelone carbonaria*) populations occur on many islands ranging from Grenada north to Anguilla, but populations often are small and many are undoubtedly declining. To see tortoises on these islands, one frequently must find the person or persons who have taken an interest in them and who will accept donations of any individuals, often keeping them in enclosures on their property. At least some of these animals date to before the advent of the pet trade in the region and are descendants of either naturally dispersed ancestors or animals carried to the islands by Amerindians in pre-Columbian times or early European settlers. In either case, tortoise populations

were likely intended to serve as food resources on future visits or during hard times. Subsequent exploitation for food, efforts at extirpation of competitors for laboriously grown vegetable crops, collection for the pet trade, and habitat alteration and destruction have depleted essentially all populations. Protection is difficult to justify when the origins of the constituent animals is uncertain. Until genetic markers can be established to distinguish long-term residents and recently escaped or released pets, protective measures aimed at specific island populations are unrealistic expectations. However, efforts to develop the necessary tools and to monitor existing populations are undoubtedly warranted on at least those islands where individuals with ancestors that arrived there by natural means are suspected to occur. Both *G. carbonaria* and *G. denticulata* (known in the region only from Guadeloupe; Breuil 2002) are listed as CITES



ROBERT POWELL

Red-footed Tortoise (*Geochelone carbonaria*) populations in the Lesser Antilles represent an amalgam of individuals that may have descended from ancestors that arrived naturally in the islands by over-water dispersal, been introduced by Amerindians or colonial Europeans (presumably as food stocks), or are recently released/escaped pets.

Table 1. Reptilian species of special concern in the Lesser Antilles. The following list includes those species that have already been recognized by CITES or the IUCN as being in need of some level of international protection. Additional annotations, many based on our observations, are listed in the last column.

Species	Island/Bank	CITES Appendix ¹	IUCN Category ²	Annotation
<i>Geochelone carbonaria</i>	Lesser Antilles	II		Systematic study
<i>denticulata</i>	Guadeloupe	II	Vulnerable ³	
<i>Cnemidophorus vanzoi</i>	Maria Major		Vulnerable ⁴	
<i>Kentropyx borckiana</i>	Barbados			Monitor
<i>Ameiva ameiva</i>	St. Vincent Bank			Monitor
	Grenada Bank			Monitor
<i>cineracea</i>	Guadeloupe Bank		Extinct ⁵	
<i>corax</i>	Little Scrub (Anguilla)			Monitor
<i>corvina</i>	Sombrero Bank			Monitor
<i>erythrocephala</i>	St. Christopher Bank			
<i>griswoldi</i>	Antigua Bank			Monitor
<i>major</i>	Îles de la Petite Terre		Extinct ⁶	
<i>plei</i>	Anguilla Bank			Monitor on St.-Martin/St. Maarten
<i>Diploglossus montiserrati</i>	Montserrat		Critically Endangered ⁷	
<i>Mabuia</i> spp.	Lesser Antilles			Monitor, systematic study
<i>Iguana delicatissima</i>	Lesser Antilles	II	Vulnerable ⁸	Upgrade status to "endangered"
<i>iguana</i>	Lesser Antilles	II		Monitor, systematic study
<i>Leiocephalus cuneus</i>	Anguilla, Barbuda, Antigua, Guadeloupe			Extinct ⁹
<i>berminieri</i>	Martinique		Extinct ¹⁰	
<i>Gonatodes</i> sp.	Union (Grenadines)			Monitor
<i>Sphaerodactylus kirbyi</i>	Bequia (Grenadines)			Monitor
<i>Alsophis antiguae</i>	Antigua Bank		Critically Endangered ¹¹	
<i>antillensis</i>	Montserrat			Monitor
	Guadeloupe		Possibly extirpated	
	Marie-Galante		Possibly extirpated	
<i>rijgersmaei</i>	Anguilla Bank		Endangered ¹²	Especially on St.-Martin/St. Maarten
<i>rufiventris</i>	Saba, St. Christopher Bank		Endangered ¹³	Extirpated on St. Kitts and Nevis
<i>sanctonum</i>	Les Saintes (Guadeloupe)			Monitor
<i>Clelia clelia</i>	Grenada	II		Possibly extirpated
<i>errabunda</i>	St. Lucia			Extinct ¹⁴
<i>Chironius vincenti</i>	St. Vincent		Critically Endangered ¹⁵	
<i>Liophis cursor</i>	Martinique Bank		Critically Endangered ¹⁶	Probably extirpated on Martinique
<i>juliae</i>	Guadeloupe, Dominica			Possibly extirpated on Guadeloupe, monitor on Dominica
<i>ornatus</i>	Maria Major		Endangered ¹⁷	Extirpated on St. Lucia
<i>perfuscus</i>	Barbados		Endangered ¹⁸	Probably extinct
<i>Mastigodryas bruesi</i>	St. Vincent, Grenada Bank			Monitor
<i>Boa constrictor</i>	Dominica, St. Lucia	II		Monitor
<i>Corallus cookii</i>	St. Vincent	II		Monitor
<i>grenadensis</i>	Grenada Bank	II		Monitor
<i>Typhlops annae</i>	St.-Barthélemy			Monitor
<i>tasymicris</i>	Grenada			Monitor

¹For criteria, see <http://www.cites.org/>, ²For IUCN Red List criteria, see http://www.redlist.org/info/categories_criteria.html, ³Tortoise & Freshwater Turtle Specialist Group 1996, ⁴Gibson 1996a, ⁵World Conservation Monitoring Centre 1996a, ⁶World Conservation Monitoring Centre 1996b, ⁷Day 1996d, ⁸Breuil and Day 1996, ⁹Breuil 2002, ¹⁰World Conservation Monitoring Centre 1996c, ¹¹Day 1996a, ¹²Day 1996b, ¹³Day 1996c, ¹⁴Underwood 1995, ¹⁵Henderson 1996, ¹⁶Breuil 1996, ¹⁷Gibson 1996b, ¹⁸Carrington et al. 1996

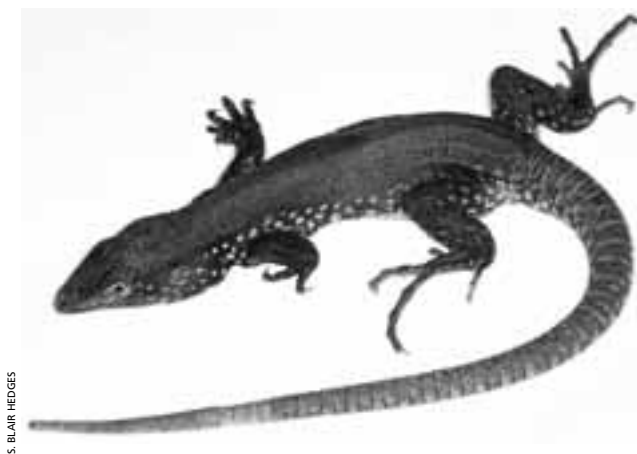
Appendix II (criteria for listing are given at: <http://www.cites.org/>), and *G. denticulata* is “vulnerable” according to IUCN Red List criteria (Tortoise & Freshwater Turtle Specialist Group 1996; for IUCN Red List criteria, see http://www.redlist.org/info/categories_criteria.html).

All other non-marine turtles found in the region are introduced semi-aquatic species in the genera *Trachemys* (Emydidae) and *Pelusios* (Pelomedusidae). The Common Slider (*T. scripta*), native to the American mainland from the southeastern United States at least into México and possibly into Central and South America, is established on St.-Martin/St. Maarten (RP, pers. obs.) and on Guadeloupe, Marie-Galante, and Martinique (Breuil 2002). The Central Antillean Slider (*T. stejnegeri*), native to Puerto Rico, parts of Hispaniola, and some Bahamian islands, has been introduced on Guadeloupe, Marie-Galante, and Les Saintes (Breuil 2002). Populations of both species are recent arrivals in the Lesser Antilles and probably originated as escaped or released pets or are descended from animals imported as food. Both have been evaluated according to IUCN Red List criteria and are considered to be at “lower risk” of becoming threatened or endangered. Schweigger’s Terrapin (*P. castaneus*) is native to West Africa and the origin of the West Indian populations on Guadeloupe and les Saintes is uncertain. Breuil (2002) noted that records of these turtles on Guadeloupe date to the early 19th Century. Consequently, since they are edible, they may have originally been introduced in association with the African slave trade. This species is listed as CITES Appendix III, based on exploitation of African turtles and with little or no consideration of the introduced West Indian populations.

Teiid and Microteiid Lizards

(Squamata: Teiidae and Gymnophthalmidae)

The St. Lucia Whiptail (*Cnemidophorus vanzoi*) is the only member of its genus in the Antilles (Presch 1971, Schwartz and Henderson 1991). Apparently endemic to two small islets, Maria Major and Maria Minor, off the coast of St. Lucia (Corke 1987), the entire population is estimated at fewer than 1000 individuals (Rowe et al. 2002). A third population has been established recently through translocation on nearby Praslin Island, from which exotic mammals (e.g., goats and rats) had



S. BLAIR HEDGES

The entire population of the St. Lucia Whiptail (*Cnemidophorus vanzoi*) is estimated at fewer than 1000 individuals.



ROBERT POWELL

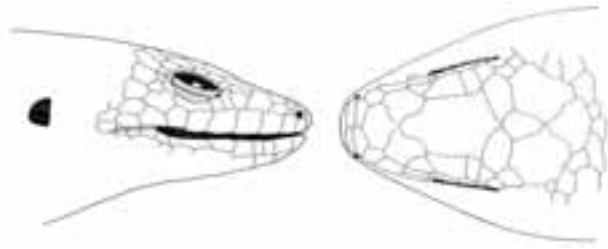
Ameiva erythrocephala appears to be doing well on mongoose-free St. Eustatius, but is essentially restricted to heavily trafficked “urban” areas on St. Christopher and Nevis.

been eradicated (Dickinson et al. 2001, John 1999). Gibson (1996a) listed the species as “vulnerable.” The relevant IUCN Red List criteria still apply, but the species is receiving the necessary attention that should keep its status from deteriorating.

Kentropyx borckiana is a unisexual species of hybrid origin that originated on the Guyana Shield and became established on Barbados following dispersal and colonization (Cole et al. 1995). Whether colonization was human-mediated is not known, nor have studies been implemented to evaluate the relationship between the Barbadian population and those on the South American mainland. The population on Barbados was once thought to be extinct (<http://users.sunbeach.net/rhinds/>), but is being encountered more frequently in recent years (Fraser et al. 1990), albeit in a very small portion of its historic range. Considering the extensive development of Barbados for agricultural purposes and, more recently, to accommodate the tourist trade, efforts to monitor this population should be encouraged.

Two Lesser Antillean species in the genus *Ameiva* are considered extinct (World Conservation Monitoring Centre 1996a,b). *Ameiva cineracea* apparently was restricted in recent times to Grand Îlet off Petit-Bourg on the eastern coast of Basse-Terre (Guadeloupe) (Schwartz and Henderson 1991), although fossil records suggest that it formerly ranged across Guadeloupe, La Désirade, Marie-Galante, and Les Saintes (Breuil 2002). *Ameiva major* was thought to occur on Martinique, but Breuil (2002) indicated instead that it was endemic to Les Îles de la Petite Terre near Guadeloupe. Breuil (2002) suggested that introduced predators and consumption by Amerindians played roles in the extinction of most populations, whereas a hurricane might have been largely responsible for the extinction of *A. major*.

The three melanistic populations of *Ameiva* from Redonda (*A. atrata*), Little Scrub Island off Anguilla (*A. corax*), and Sombrero (*A. corvina*) appear to be thriving in their respective island habitats. A documented capacity to survive potentially catastrophic natural events (e.g., hurricanes) and isolation on islands that discourage human access while offering little in the way of attractions seem to have served them well (e.g., Censky and Paulson 1992, Censky and Powell 2001). However, the very small size of these islands (Little Scrub 1.2 ha, Sombrero 38.4 ha, Redonda 130 ha) and the seasonal abundance and scarcity of food resources renders all three of these populations vulnera-



The critically endangered Montserrat Galliwasp (*Diploglossus montisserrati*) is known only from a single specimen and very few sightings. This drawing of the holotype is from Underwood (1964).

ble to unforeseen stochastic events. IUCN Red List criteria would qualify all three species for listing, although none are currently offered any formal protective status and all should be closely monitored.

Populations of other species of *Ameiva* also have declined dramatically, but they remain common in at least some portion of their historic range. *Ameiva plei* is common on Anguilla and some of its satellites (e.g., Hodge et al. 2003) and on St.-Barthélemy (Breuil 2002), but populations on mongoose-infested St.-Martin/St. Maarten are localized, and the species is absent from many areas that apparently provide suitable habitat and adequate resources (Breuil 2002). Similarly, *A. erythrocephala* appears to be doing quite well on mongoose-free St. Eustatius (Kerr et al. 2005, Rojer 1997a), but is essentially restricted to heavily trafficked “urban” areas on St. Christopher and Nevis (Barbour 1930a, Malhotra and Thorpe 1999, Westermann 1953). *Ameiva griswoldi* is rarely encountered on Antigua (RP, pers. obs.), but remains abundant on several offshore islets and is common on Barbuda, despite the potential for extensive predation by feral cats (RWH, pers. obs.). Populations of *A. ameiva* on Grenada and The Grenadines also appear to be largely restricted to areas where high levels of human activity may moderate mongoose predation (Germano et al. 2003, Simmons et al. 2005), but many populations on St. Vincent are extirpated (Corke 1992). No recent surveys have addressed the status of *A. pluvianotata* on Montserrat. However, because of its largely lowland distribution (Schwartz and Henderson 1991), most populations probably were not affected dramatically by the ongoing eruptions of the Soufrière Volcano.

Lesser Antillean microteiid (Family Gymnophthalmidae) are comprised of insular populations of species with broad South American distributions (e.g., Williamson and Powell 2004). *Bachia heteropa* is a burrowing/litter-dwelling form that appears to be holding its own on Grenada (Germano et al. 2003) and The Grenadines. Parthenogenic populations of cryptozoic species in the genus *Gymnophthalmus* are either expanding their ranges to new islands or are merely being discovered on islands where these small, inconspicuous lizards may have been present for some time. No populations appear to be threatened by current levels of human activity.

Lizards: Galliwasp and Skinks (Squamata: Anguillidae and Scincidae)

In his description of the Montserrat Galliwasp, *Diploglossus montisserrati*, Underwood (1964) quoted the collector of the holo-

type as saying that he had seen this lizard only once before, and that was twenty-five years previously. Stevens and Waldman (2001) listed several more recent sightings (through 2001), but no successful efforts at collecting additional animals. Day (1996) considered the species to be “critically endangered.” Although recent records suggest that the population is extant, the rarity of encounters and the unknown effects of recent volcanic activity on moist woodland habitats seemingly preferred by these lizards warrant extensive efforts to determine the current population size and distribution of this species, which may very well be one of the most endangered lizards in the world.

Although *D. montisserrati* is the only anguillid native to the region, skinks in the genus *Mabuya* occupy similar niches on many islands (Breuil 2002, Schwartz and Henderson 1991). Although widespread, they are nowhere abundant, and populations on St.-Martin/St. Maarten, Basse-Terre (Guadeloupe), Marie-Galante, and Martinique have apparently been extirpated (Breuil 2002). Predation by mongooses, cats, and other exotic predators and deforestation with a resultant loss of surface litter on which these animals depend appear to be primarily responsible for these lizards’ extirpations, rarity, and possible population declines. Much of the lack of concern may be attributable to the assumption that these are relatively recent introductions of one or two species that are widely distributed on the American mainland. However, no detailed systematic studies exist and, since potentially threatened endemic taxa could be hidden among populations currently assigned to *M. mabouya* or *M. sloanii*, establishing the identity and relationships of Antillean populations and those in South America (see comments in Mayer and Lazell 2000, Miralles 2005, and Powell and Henderson 2003) should be high priorities for researchers in the region.

Iguanian Lizards

(Squamata: Iguanidae, Leiocephalidae, Polychrotidae)

Unlike its more familiar relative, the Common or Green Iguana (*Iguana iguana*; see below), which has an extensive range throughout much of the Neotropics, the Lesser Antillean Iguana (*I. delicatissima*) is endemic to this region. The species’ original range extended from Martinique in the south to Anguilla in the north. However, populations have been extirpated on Barbuda, Saint Kitts, Nevis, Antigua, Les Îles des Saintes, Marie-Galante, and St.-Martin/St. Maarten (Fogarty et al. 2004, Powell 2004).



Skinks in the genus *Mabuya* are widely distributed in the Lesser Antilles, but are nowhere abundant, and several populations have apparently been extirpated.



SEAN P. FOGARTY

The Red List status of Lesser Antillean Iguanas (*Iguana delicatissima*) should be reevaluated and almost certainly upgraded to “endangered.” This male was foraging in the Boven Hills of St. Eustatius.

Breuil (2002) recently listed the populations on Dominica, Îles de la Petite Terre, and La Désirade as vulnerable. Apparently only that on Petite Terre is stable and only that on Dominica is of even moderate size (Anonymous 2004). However, even the “stable” population on Petite Terre suffered greatly during a prolonged drought in 2001 (Breuil 2002 and references therein). Breuil (2002) listed populations on Basse-Terre, Îlet Chancel (Martinique), and St.-Barthélemy as endangered, and those on Antigua, Anguilla, Barbuda, Île Fourchue and satellites (St.-Barthélemy), Grande-Terre, Martinique, St.-Martin/St. Maarten, and St. Eustatius as critically endangered — and those on Antigua, Barbuda, and St.-Martin/St. Maarten have already disappeared (Fogarty et al. 2004, Powell 2004), along with populations on St. Christopher, Nevis, and Marie-Galante. Along with all iguanas, the species is listed in CITES Appendix II and as “vulnerable” in the most current IUCN Red List (Breuil and Day 1996). All populations are protected by local regulations from hunting, although enforcement ranges from non-existent to sporadic.

Two additional, separate threats face populations of *I. delicatissima* on St. Eustatius and on Martinique, Guadeloupe, and possibly Anguilla. Mexican Creeper (*Antigonon* sp.) was intro-

duced onto St. Eustatius as an ornamental garden plant, but has escaped and covers entire regions of the island, where it actively threatens native vegetation (Fogarty et al. 2004). No effective means of control has been identified. Even goats find the Creeper unpalatable and will eat it only in the absence of alternatives. The impact on plants consumed by iguanas has not been assessed, but the danger is obvious.

The threat facing populations of *I. delicatissima* on Martinique and Guadeloupe is the possibility of hybridization with introduced populations of *I. iguana*. The possibility of previous, “natural” contact between the two species on various Lesser Antillean islands cannot be disregarded, despite the fact that the natural distribution of the two species appears to be allopatric. Fossil remains of *I. iguana* are known from Grande-Terre (Guadeloupe), where *I. delicatissima* presumably occurs naturally. Also, Breuil (2002) noted that the one figure in Seba (1734) that was not an illustration of *I. iguana* and on which Laurenti (1768) largely based his description of *I. delicatissima* was probably a hybrid, indicating that contact between the two species is not a recent phenomenon (see Pasachnik et al. 2005 for a complete list of pertinent references and an extensive discussion of the species’ nomenclatural history). Intermittent con-

tact, with the possibility of introgression into native populations of either species, quite possibly occurred on several islands (although the statement in Anonymous 2004 that “Dominica, La Désirade and La Petite Terre are the only islands where just *Iguana delicatissima* is thought to live” is not warranted or accurate, as no reason exists to doubt the “purity” of populations on Anguilla or St. Eustatius). Regardless, in recent years, human-mediated introductions of *I. iguana* onto islands inhabited by *I. delicatissima* and reductions in the extent of suitable habitat caused by human encroachment have dramatically magnified the frequencies of contact between the two species on Martinique and Guadeloupe, where populations of “pure” *I. delicatissima* have essentially disappeared.

In light of documented declines in many populations, ongoing habitat destruction and alterations, continuing competition with introduced mammalian herbivores, predation by

alien predators on many islands, and possible contamination of the gene pool as a consequence of interbreeding with introduced populations of Green Iguanas (Pasachnik et al. 2005), the Red List status of the species should be reevaluated and almost certainly upgraded to “endangered.” Only the fact that populations remain on multiple islands precludes assignment of “critically endangered” status.

Like Lesser Antillean populations of tortoises (see above), those of Green Iguanas (*Iguana iguana*) may be descendants of ancestors that arrived in the islands by natural (non-human-mediated) overwater dispersal, have been introduced by Amerindians (probably for food), established recently as a consequence of escaped pets, or combinations thereof (Powell 2004). Presumably native populations occur on Grenada, St. Vincent, The Grenadines, St. Lucia, Saba, and Montserrat. Populations of unknown or mixed origin are on Martinique,



ROBERT POWELL

Priority should be given to better understanding the unique populations of *Iguana iguana* on Saba, Montserrat, and St. Lucia. This individual is from Saba.

Guadeloupe, Les Îles des Saintes, and Marie-Galante; and populations presumed or known to be introduced occur on Antigua, Barbuda, St.-Martin/St. Maarten, and Anguilla. A presumably natural population on Barbados is extirpated (Breuil 2002).

Because of the species' broad continental range, which extends from México through Central America and much of northern South America, and a general lack of recognition of genetic variability among populations, protective measures are considerably less stringent than for *I. delicatissima*. *Iguana iguana* is listed in CITES Appendix II, but export quotas exist for many countries, primarily for live animals (pet trade) or products (leather goods and meat). No distinction is made for native versus introduced or for continental versus insular populations. Hunting is usually prohibited, but enforcement of laws is lax at best. In Grenada, Green Iguanas are considered game animals (Powell 2004), with a "regulated" hunting season and bag limits. Both are routinely ignored by local hunters.

Basic surveys are necessary on Montserrat, where the status of the *I. iguana* population is unknown and on islands, such as St. Vincent, The Grenadines, and Grenada, from which we have no current data on the populations. Field research on the basic biology of populations are needed for all populations, but priority should be given to better understanding the genetically unique populations of *I. iguana* on Saba, Montserrat, and St. Lucia (Malone et al. 2004, Morton 2004), all of which might warrant recognition as distinct species (Powell 2004).



This woodcut of a "roquet" in Rochefort (1658) undoubtedly represents *Leiocephalus cuneus* and provides convincing evidence that the species was extant during the colonial period (from Breuil 2002).

Other iguanian lizards in the region include the ubiquitous and scansorial anoles (*Anolis*), which are found on essentially every island capable of supporting any vegetation. These lizards appear to adapt well to alterations of their habitats, functioning as human commensals in many instances (Henderson and Powell 1999, 2001). However, we cannot predict the effects on native species by introduced anoles. Documented instances in the Lesser Antilles (*A. carolinensis* on Anguilla, Eaton et al. 2001;



ROBERT POWELL

Anoles, such as this *Anolis sabanus* from Saba, are found on essentially every island capable of supporting any vegetation and appear to adapt well to alterations of their habitats, functioning as human commensals in many instances.



ROBERT POWELL

Alsophis rufiventris remains abundant on mongoose-free Saba and St. Eustatius, but has been extirpated on mongoose-infested St. Christopher and Nevis.

A. sagrei on Grenada, Greene et al. 2002; *A. cristatellus* on Dominica, Powell and Henderson 2003; and the apparently unsuccessful colony of *A. bimaculatus* on St.-Martin/St. Maarten, Powell et al. 1992) suggest that the introduced species are limited to areas of dramatically altered habitats, where they presumably pose little threat to native congeners. These are all relatively recent introductions, however, and longer-term effects are unknown.

In stark contrast to the anoles and more comparable to the fate of many populations of *Ameiva* is the apparent status of terrestrial Curly-tailed Lizards (*Leiocephalus*). Two species occurred in the Lesser Antilles, and both appear to have become extinct in historical times, albeit prior to the introduction of the mongoose (Breuil 2002, World Conservation Monitoring Centre 1996c). *Leiocephalus cuneus* may once have been widespread (fossil remains assigned to *L. cf. cuneus* are known from

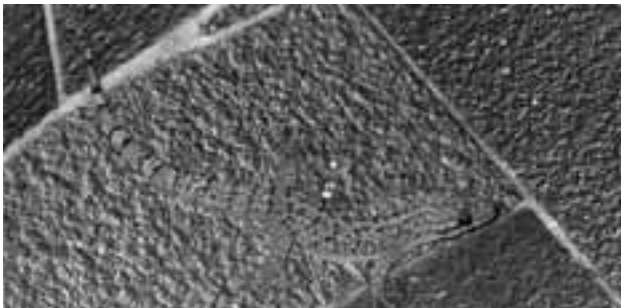
Anguilla, Barbuda, Antigua, and Guadeloupe; Breuil 2002, Schwartz and Henderson 1988), whereas *L. herminieri* is known only from Martinique. No specimens of the latter have been taken since the 1830s (World Conservation Monitoring Centre 1996c). The association of remains with archaeological sites suggests that pre-Columbian human activities may have contributed to these species' declines, although populations of both were apparently extant after European colonization.

Geckos

(Squamata: Gekkonidae)

Phyllodactylus pulcher is the only Leaf-toed Gecko known to occur in the Lesser Antilles. The species is endemic to Barbados, where it presumably is "nocturnal, arboreal, and insectivorous" (Dixon 1962, Schwartz and Henderson 1991). Although some references to edificarian habits exist (e.g., <http://users.sunbeach.net/rhhinds/>), known localities for the species are limited and its range has not been systematically investigated (Government of Barbados 2002). The species is considered rare (Ministry of Physical Development and Environment, Barbados 2001). Surveys seeking to establish the distribution and abundance of this Barbadian endemic should be encouraged, especially since insular populations of Leaf-toed Geckos elsewhere appear to be vulnerable to population declines when faced with competition from House Geckos in the genus *Hemidactylus* (G. Köhler, pers. comm.).

Other geckos known to occur on Lesser Antillean islands include two species of House Geckos (*Hemidactylus*), the Turnip-tailed Gecko (*Thecadactylus rapicauda*), various species of Dwarf Geckos (*Sphaerodactylus*), an undescribed species of Clawed Gecko (*Gonatodes*), and the introduced Tokay Gecko



R.H. HINDS

The Barbadian Leaf-toed Gecko (*Phyllodactylus pulcher*) is the only known member of its genus to occur in the Lesser Antilles. Essentially nothing is known about its natural history, distribution, or abundance (<http://users.sunbeach.net/rhhinds/Leaf%20Toed%20Gecko.html>).

Table 2. Presence or absence of species of *Ameiva*, *Alsophis*, *Liophis*, and the mongoose (*Herpestes javanicus*) on Lesser Antillean islands. A “+” indicates presence and a “–” indicates absence of the mongoose or absence of a species of *Ameiva*, *Alsophis*, and/or *Liophis* from an island where that species once occurred. An asterisk (*) indicates that, if the species still occurs on the island, it is very rare or restricted to isolated enclaves. The absence of either a “+” or a “–” denotes that no record of that taxon occurring on that island exists. Many small islands and cays not listed here may support *Ameiva* populations and have no mongooses. *Alsophis* also is known from Barbuda, but only as a fossil.

Island	Mongoose	<i>Ameiva</i>	<i>Alsophis</i>	<i>Liophis</i>
Sombrero	–	+		
Anguilla	–	+	+	
Scrub	–	+	+	
Little Scrub	–	+		
St.-Martin/ St. Maarten	+	+	+	*
St.-Barthélemy	–	+	+	
Saba	–		+	
St. Eustatius	–	+	+	
St. Christopher	+	+	–	
Nevis	+	+	–	
Antigua	+	+	–	
Great Bird	–	+	+	
Barbuda	–	+		
Redonda	–	+		
Montserrat	–	+	+	
Guadeloupe	+		+	+
Terre-de-Haut	–		+	+
Terre-de-Bas	–		+	
Marie-Galante	+		–	+
Dominica	–	+	+	+
Martinique	+		–	
Rocher de Diamant	–			+
St. Lucia	+			–
Maria Major	–			+
Barbados	+			–
St. Vincent	+	+		
Grenada	+	+		

(*Gekko gekko*). House geckos are human commensals and are abundant nearly everywhere. Turnip-tailed Geckos are widely distributed, but appear to be less common than House Geckos, although that might be attributable largely to habitat preferences for forested areas rather than buildings (e.g., Howard et al. 2001). Many Dwarf Geckos are phenomenally abundant (e.g., *S. parvus* and *S. sputator* on Anguilla or *S. sabanus* and *S. sputator* on St. Eustatius; Nava et al. 2001, Hensley et al. 2004), but others, such as *S. elegantulus* on Antigua are rarely encountered, even in apparently suitable habitat (RP, pers. obs.). The first Dwarf Gecko to be found on the Grenada Bank, *S. kirbyi*, was described from six specimens in the mid-1990s (Lazell 1994). It has so far been recorded only from Bequia, one of the northernmost of The Grenadines. The population on Bequia should be monitored and other islands in The Grenadines should be surveyed for Dwarf Geckos, as should Grenada, the only major landmass in the Windward Islands that does not harbor a species of *Sphaerodactylus*. The undescribed Clawed Gecko (*Gonatodes*



Like populations of other diurnal, terrestrial reptiles, *Liophis*, like this *L. juliae* from Dominica, is extremely vulnerable to predation by introduced mongooses.

sp.) appears to be restricted to leaf litter in mature upland dry forest on Union Island in the Grenadines. Nothing is known about the distribution or natural history of this species, the habitat of which should be monitored closely.

Common Snakes (Squamata: Colubridae)

The ranks of the Colubridae, like the ground-dwelling *Ameiva* lizards, have suffered the greatest number of extirpations, extinctions, and/or dramatic reductions in geographic ranges in the West Indies in general and the Lesser Antilles in particular. West Indian Racers (*Alsophis*) are, essentially, snake counterparts of *Ameiva*. They are ground-dwelling, diurnal, fast-moving, oviparous, and apparently susceptible to predation by ground-dwelling, diurnal, fast-moving mongooses. Although some species on some islands harbor healthy racer populations (e.g., *Alsophis antillensis* on Dominica and Montserrat, *A. rijgersmaei* on Anguilla and St.-Barthélemy, and *A. rufiventris* on Saba and St. Eustatius; Breuil 2002, Heinz et al. 2004, Henderson 2004, Hodge et al. 2003, Maley et al. 2005, Malhotra and Thorpe 1999, Rojer 1997a,b, Savit et al. 2005, RWH and RP, pers. observ.), populations of the same species are restricted to small, isolated enclaves on St.-Martin/St. Maarten (*A. rijgersmaei*; Powell et al. 1992, Rojer 1997c, Breuil 2002) and extirpated on Antigua (*A. antiguae*), Marie-Galante (*A. antillensis*), St. Christopher and Nevis (*A. rufiventris*), and possibly Guadeloupe (*A. antillensis*) (Barbour 1930a, Henderson 1992, 2004, Maley et al. 2005, Sajdak and Henderson 1991, Sajdak 2004). In each instance, the mongoose appears to be primarily responsible.

If mongooses are present on an island, racers have usually been extirpated; if the mongoose is absent, racer populations are healthy (Table 2). A textbook example is illustrated by the situation on Antigua and one of its satellite islands. Mongooses were introduced onto Antigua in the late nineteenth century (Henderson 1989), and, in 1936, Parker declared *A. antiguae* extinct. Apparently unknown to Parker, however, a population of *A. antiguae* survived on the small (9.9 ha) mongoose-free satellite known as Great Bird Island, situated 2.5 km off the northeastern coast of Antigua. Valiant efforts are being made to insure that the Great Bird Island population of *A. antiguae* does not go the way of the main island populations (Daltry et al. 2001).

Grove Snakes (*Liophis*) are, like racers, ground-dwelling, diurnal, oviparous, and have been extirpated on islands where mongooses have been introduced (Table 2). For the most part, they occur on islands south of the range of *Alsophis*, although Guadeloupe, Marie-Galante, and Dominica have or had representatives of both genera. Grove Snakes have been eliminated from Martinique (*L. cursor*), St. Lucia (*L. ornatus*), and Barbados (*L. perfuscus*). A satellite population of *L. cursor* occurs on Rocher de Diamant (0.06 km²) and, similarly, a satellite population of *L. ornatus* occurs on Maria Major (0.09 km²) off the coast of St. Lucia. The status of both of these populations is, at best, precarious. *Liophis juliae* occurs on Guadeloupe and Dominica. It is rare to possibly extirpated on mongoose-infested Guadeloupe and, conversely, it is widespread and common on mongoose-free Dominica.

Two species of *Clelia*, often called “cribo” in the West Indies, are somewhat of an enigma. *Clelia clelia* (CITES Appendix II) may reach 2.0 m and is a powerful snake that is capable of constriction and injecting venom via fangs situated in the rear of the upper jaws. The venom is effective for subduing vertebrate prey (mostly snakes and small mammals). Because it shares characteristics with *Alsophis* and *Liophis* (ground-dwelling, sometimes diurnal), it may be or may have been vulnerable to mongoose predation. It may never have been common in the West Indies (Henderson 2004). During fieldwork spanning 15 years on Grenada, RWH has never encountered this species, and Grenadians concur that it is a very rare snake. Most adults have not seen one since they were children. Although the species warrants protection on Grenada, we are uncertain how to effectively establish protection for a species that most people have never seen and therefore would not know it if they did see it. *Clelia errabunda* was endemic to St. Lucia. It is now extinct, and Underwood (1995) attributed its disappearance to human activity.

A single species of *Mastigodryas* (*M. bruesi*) occurs on St. Vincent and the Grenada Bank. It has been introduced to Barbados, possibly via banana shipments that originated in St. Vincent (Underwood et al. 1999). This slender, diurnal snake was often encountered sleeping in trees on St. Vincent in the late 1980s, but surveys in the early 1990s failed to produce any sightings. Barbour (1914) described this species as “... apparently, the most abundant ophidian on the island [of Grenada].” Whether or not that was an accurate statement in 1914 is impossible to say (see comments in Henderson and Powell 2005 regarding the accuracy of Barbour’s assessments of herpetofaunal abundance), but it doesn’t apply today. Barbour (1930a, 1930b, 1935, 1937) declared the species extinct on St. Vincent and “very rare” on Grenada. Corke (1992) noted that the species was “relatively common,” but might have been referring solely to St. Vincent. The species apparently is rare in Grenada (Greene et al. 2003). RWH has not observed a live individual over a 15-year span, but two field associates saw individuals at two different sites in 2003. The species may be more common on at least some of The Grenadines, but it has been over a decade since active fieldwork has been conducted there. Although its arboreal tendencies (Schwartz and Henderson 1991) might provide some protection from predation by terrestrial mongooses (Sajdak and Henderson 1991), the species’ uncertain status throughout its known range certainly calls for survey work and possible monitoring.



ROBERT POWELL

The largely arboreal habits of *Mastigodryas bruesi* appear to render this species somewhat less vulnerable to mongoose predation than more terrestrial colubrid snakes in the region.



ANITA MALHOTRA

Boa Constrictors (*Boa constrictor*), such as this individual from Dominica, are subject to persecution on the Lesser Antillean islands where they occur; although not in imminent danger of eradication, populations should be monitored.



ROBERT W. HENDERSON

Whether the apparent recent decline in the numbers of treeboas (*Corallus grenadensis*) is a natural phenomenon or not is uncertain.

Chironius, a geographically and ecologically widespread genus on the Neotropical mainland, is represented by a single species in the West Indies. *Chironius vincenti* is endemic to St. Vincent. Henderson et al. (1988) described the first specimen to reach a museum in over 100 years. This may be the most habitat-dependent snake species in the Lesser Antilles. Snakes are restricted to primary and secondary forests at elevations from 275–600 m, where they are active by day on the ground and in trees and where they feed on anurans (Henderson and Haas 1993). Radical modification of primary and secondary forests on St. Vincent would have serious consequences for *C. vincenti*; it is considered “critically endangered” on the IUCN Red List (Henderson 1996).

Boas (Squamata: Boidae)

The Boa Constrictor (*Boa constrictor*) is restricted to Dominica and St. Lucia in the Lesser Antilles, and each island supports an endemic subspecies (*B. c. nebulosus* and *B. c. orophias*, respectively). On Dominica, the species is exploited for its fat, which is rendered and the resultant oil is used to treat arthritis and other joint ailments (Malhotra and Thorpe 1999; M. Day, *in litt.*). Boa Constrictors are subject to persecution merely because they are snakes, and also because they may represent a potential danger to humans as a consequence of their size. To the best of our knowledge, *B. constrictor* populations in the Lesser Antilles are not in imminent danger of eradication, but they should be monitored.

The treeboas *Corallus cookii* and *C. grenadensis* are Lesser Antillean endemics on St. Vincent and the Grenada Bank, respectively. *Corallus cookii* was moderately common when last surveyed in the late 1980s and early 1990s (Henderson 2002). *Corallus grenadensis* occurs on ten islands (Grenada plus nine of The Grenadines). We have not surveyed populations on The Grenadines for over a decade, but we assume all populations are still extant. Population declines have been observed on Grenada (Henderson 2002, Henderson and Berg 2005), but we are unable to state with any certainty why they have occurred. We have seen declines at sites where treeboas were being captured, marked, and released; we have also witnessed them where no handling occurred. Although Henderson (2002) did not agree with



HANS E. A. BOOS

Pit-viper populations may have benefited from the introduction of the mongoose, as larger snakes readily consume them. This *Bothrops lanceolatus* is from Martinique.



S. BLAIR HEDGES

Because of the secretive habits of snakes in the genus *Typhlops*, assessing the status of these small ant- and termite-eating snakes can be difficult. This is *T. geotomus* from Nevis.

Grenadians that *C. grenadensis* was not as common as they once were, he now concurs that, certainly at some sites, numbers have dwindled (Henderson 2003, Henderson and Berg 2005). The depression in numbers we are now seeing may be a natural phenomenon, and numbers might eventually increase again. Regardless, the situation on Grenada warrants monitoring.

Pit-vipers (Squamata: Viperidae)

Two species of Pit-vipers occur in the Lesser Antilles: *Bothrops caribbaeus* on St. Lucia and *B. lanceolatus* on Martinique. Both species survived years of having bounties on their heads. Although bounties are no longer offered, over a seven-year period in the 1960s, bounties on more than 50,000 *B. lanceolatus* were collected on Martinique (Pinchon 1967). These snakes undoubtedly are routinely killed when encountered by humans. Nevertheless, we are led to believe that both species remain common on their respective islands (Lazell 1964, Powell and Wittenberg 1998). Lazell (1964) even suggested that, unlike so many other West Indian endemic snakes and lizards, *Bothrops* may have benefited from the introduction of the mongoose, as larger individuals readily consume mongooses.

Blind Snakes and Thread Snakes

(Squamata: Leptotyphlopidae and Typhlopidae)

Because of the secretive habits of these small ant- and termite-eating snakes, assessments of their status are difficult. *Leptotyphlops bilineatus* (Martinique, St. Lucia, Barbados) and *Typhlops geotomus* (St. Christopher Bank, Antigua Bank) have multi-island distributions and likely have healthy populations. Conversely, *T. annae* (St.-Barthélemy), *T. monastus* (Montserrat), *T. guadeloupensis* (Guadeloupe), *T. dominicanus* (Dominica), and *T. tasymicris* (Grenada) have single-island distributions and some species may deserve legislated protection. *Typhlops dominicanus* is widespread on Dominica (Malhotra and Thorpe 1999), and we have had no trouble finding *T. guadeloupensis*. *Typhlops annae* was only recently described (Breuil 1999) and it occurs on a small (22 km²) island; its status should be monitored. *Typhlops tasymicris* was discovered in 1968 (Thomas 1974) and, since then, only one additional specimen has been deposited in a scientific collection (Wallach 2000). We have made unsuccessful efforts to collect it (or even to find someone on Grenada who is

familiar with the species). We are unaware of the status of *T. monastus*. Its relatively extensive distribution on Montserrat (Schwartz and Henderson 1991) would suggest that the species is secure despite recent volcanic activity on that island. Possible effects resulting from the introduction of *Ramphotyphlops braminus* on Anguilla, St.-Martin/St. Maarten, and St.-Barthélemy (Breuil 2002, Censky and Hodge 1997) are unknown.

Summary

Many Lesser Antillean reptiles are habitat generalists, descendants of effective colonizers, and often adapt well to human-mediated alterations of their environments. The most obvious examples are the many anoles that probably were arboreal historically, but adapt readily to almost any vertical structure. Furthermore, they are heliothermic to varying degrees and seem to thrive in situations in which human activity has created habitat edges. Also apparently doing well are some of the nocturnally active species (e.g., *Hemidactylus* and *Thecadactylus*), those that are small and inconspicuous (e.g., *Gymnophthalmus* and some *Sphaerodactylus*), and species that spend most of their lives underground (e.g., *Bachia* and most *Typhlops*).

In sharp contrast, many other reptiles have seen populations decline precipitously and even disappear altogether. Particularly vulnerable are species that are associated primarily or solely with pristine habitats that no longer exist on most islands, are large and can serve as an economic commodity, inspire fear, or are diurnally active and terrestrial. Undoubtedly the most widely applicable effects on the majority of species are associated with habitat destruction or change. Species, such as *Diploglossus montisserrati* or *Chironius vincenti*, for example, that are adapted to either dry lowland forests or lush rainforests, usually at higher elevations, often suffer as trees are cleared to make way for agriculture, human housing and associated infrastructure, or the demands of the tourist industry. Iguanas often suffer when forced to compete for food with introduced mammalian herbivores, and Treeboas (*Corallus*) require a contiguous



ALAIN FOSSE

In the absence of mongoose (*Herpestes javanicus*) introductions, extirpations of terrestrial reptiles in the Lesser Antilles would be far less common.

Table 3. Factors that may contribute to extinctions, extirpations, range constrictions, and/or declining populations in Lesser Antillean reptiles.

Factor	Examples
Introduced predators	cats, dogs, mongooses, rats
Introduced competitors	<i>Gekko gekko</i> , <i>Elaphe gutatta</i> , herbivorous mammals
Habitat modification due to development	housing for growing human population; hotels and golf courses for tourism
Habitat modification to sustain human population	deforestation to create pastures or livestock; fields for crop production, charcoal production
Habitat modification due to free-ranging livestock	cropping of vegetation to dirt level by goats, sheep, burros, pigs, and cattle
Natural catastrophes	hurricanes

canopy that exists in increasingly fewer localities within their ranges. Some, such as the tortoises, the iguanas, and even *Boa constrictor*, are exploited directly for food or other marketable products. Others, such as nearly all of the snakes, are persecuted by residents who consider them all dangerous.

Factors that may contribute to declining populations (and, potentially, extirpation or extinction) are listed in Table 3. With the exception of natural catastrophes, the one variable that the rest of these factors have in common is the human element. The first four categories all require human involvement. With so many factors that are capable of contributing to the extinction, extirpation, or obvious decrease in population numbers or constricted geographic ranges, singling-out one factor to explain a geographically broad pattern of extirpations may seem irresponsible. However, the geographically broad scope of the extirpations points to a single factor and, more importantly, to a single species: *Herpestes javanicus*. The almost complete correlation between the presence of mongooses and the decline or absence of terrestrial lizards (e.g., *Ameiva*, possibly *Mabuya*) and snakes (e.g., *Alsophis*, *Liophis*) (Table 2) clearly indicates that this introduced predator has, in fact, directly contributed to the decline, extirpation, and even extinction of Lesser Antillean reptiles. This assertion differs with Corke (1992), who suggested that no conclusive evidence existed for the widely reported role of introduced mongooses in the decline of the islands' reptiles. Likewise, Baskin and Williams (1966) were, at best, ambivalent regarding the impact of *Herpestes* on *Ameiva*. Although we concede that other factors (e.g., overdevelopment; cats, dogs, and rats) have contributed to the decline or elimination of a particular species from an island, we contend that, in the absence of mongoose introductions, extirpations would be far less common in the Lesser Antilles.

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RELLY BRADLEY

Male *Cyclura pinguis* (no. 9) one year after the initial release. This iguana traveled only about 13 m from the original release site on Middle Cay.

Conservation of the Anegada Iguana (*Cyclura pinguis*)

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Abstract.—The long-term survival of the Anegada Iguana (*Cyclura pinguis*) is uncertain. The species is in danger of becoming extinct due to habitat destruction, competition with feral livestock, and the introduction of non-native mammalian predators. In an effort to save the Anegada Iguana, the IUCN Iguana Specialist Group and the British Virgin Islands National Parks Trust began a concerted conservation effort in 1997. They initiated a headstart program in order to bolster the wild population until many of the problems facing the iguanas can be minimized or removed. Headstarted iguanas were released back into the wild in October of 2003 and 2004. This paper briefly reviews the natural history of *C. pinguis* and presents some preliminary results from the ongoing long-term monitoring of the subadult iguanas reintroduced to the wild.

Key Words: Anegada Iguana, *Cyclura pinguis*, British Virgin Islands, Conservation, Headstarting, Reintroduction, Radiotelemetry

Natural History

Herbivorous Rock Iguanas (Iguanidae: *Cyclura*) occur only in the West Indies. The critically endangered Anegada Iguana (*Cyclura pinguis*) is one of the largest species in the genus. Adults can grow to 550 mm in snout-vent length (SVL) and weigh up to 7 kg (Carey 1975). Genetic studies have shown this species to be the most basal of extant lineages (Malone et al. 2000). The extent of the historical range is uncertain. The species is known to have occurred on Puerto Rico, where cave fossils date from 15,000–20,000 years ago, before the arrival of humans (Pregill 1981). Fossil evidence also has been found on St. Thomas (U.S. Virgin Islands). These remains, however, are associated with Native American middens (Miller 1918). Whether these remains were imported or collected locally is

unknown. Regardless, presumably before Europeans arrived in the Americas, the Anegada Iguana became restricted to the island of Anegada in what is now the British Virgin Islands (BVI).

Since 1984, the species' range has been expanded through the introduction of iguanas from Anegada to Guana, Necker, and, most recently, Norman Island, all three of which are also in the BVI (Goodyear and Lazell 1994, Lazell 1995). These islands are privately owned and afford these established populations some protection from threats facing the population on Anegada. These satellite populations appear to be thriving, and serve as a hedge against extinction for the species as a whole.

On Anegada, iguanas typically are found in two habitat types, sandy scrub or rocky woodland. Sandy scrub is charac-





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A hatchling *Cyclura pinguis* emerges from a nest that was excavated in July by a female in the Bones Bight area of Anegada.

terized by small to medium-sized woody shrubs, grasses, and some larger trees. Vegetation can be very dense and can limit access in some areas. In this habitat, iguanas dig burrows for retreats. Rocky woodland has a limestone substrate with many holes and crevices that iguanas use as retreats. Vegetation is composed of some smaller shrubs, tall mature trees, and cacti. Vegetation at both sites supplies iguanas with food (leaves and fruit), shade, and retreats.

Reproductive activity is tied to seasonal changes that promote a high hatch rate (Alberts 2000, Harris 1982, Rand and Green 1982, Wiewandt 1982). The mating season falls in May and June. Females dig nests from late June through July, shortly after the spring rains, when the ground is soft. Temperatures are high during the summer 90-day incubation period. Hatchlings emerge during the wet fall, when food resources are most abundant (Gerber 2000).

Females can lay up to 20 eggs, although the average is 13. The reproductive strategy of producing fewer but larger offspring is the result of evolving in a predator-poor environment. This strategy, however, renders the species very vulnerable to introduced predators that target juveniles. In contrast, the Green Iguana (*Iguana iguana*), which evolved in the predator-rich environments of Central and South America, can produce clutches of fifty eggs. Consequently, introduced Green Iguanas can become established even on islands with effective predators such as cats and mongooses.

Conservation Status and Major Threats

The Red List of the International Union for the Conservation of Nature and Natural Resources currently lists *C. pinguis* as "Critically Endangered" (IUCN 2004) and the species is listed in Appendix I by the Convention on the International Trade of Endangered Species of Wild Fauna and Flora (CITES 2004). Recent population estimates suggest that the Anegada Iguana has suffered an 80% decline in numbers since the late 1960s (Mitchell 1999). Accurately estimating population size is difficult because of the species' secretive nature and fragmented population. The most recent estimates are 200 wild adults and 44 repatriated iguanas on Anegada (Gerber 2004) plus 80 individ-



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Fort Worth Zoo veterinarians surgically place transmitters into the coelomic cavity of each iguana.

uals currently in the headstart facility (Walker, pers. comm.), 130 on Guana, and 30 on Necker (Perry and Mitchell 2003). These low numbers suggest that *C. pinguis* is one of the most endangered lizards in the world.

Cyclura pinguis faces many threats. Human encroachment is destroying the remaining habitat. An ongoing controversy over land ownership on Anegada has resulted in many of the long-term residents being unable to acquire clear title to land on which they have lived for generations, and many locals have negative feelings toward establishing a large national park that incorporates most of the core iguana area. A portion of the core iguana area on Anegada is within a Ramsar site (Ramsar Convention on Wetlands), which is internationally protected wetland. However, the most productive nesting area for the remaining population is currently unprotected.

A second major threat to the survival of *C. pinguis* is the large feral livestock population. Large herds of cattle, donkeys, goats, and sheep range freely. Simply by stepping on them, live-



LEE PAGANI

The staff of the British Virgin Islands National Trust (Nevil Vanterpoole, Raymond Walker, and Rondel Smith) and Sylvia Faulkner, a local resident who participated in the release of headstarted iguanas back into the wild.



LEE PACINI

A rare hatchling *Cyclura pinguis* was captured along the road near Pomato Point on Anegada. This individual was transferred to the headstart facility after being weighed and measured and having a blood sample taken for genetic studies.

stock can collapse burrows and nest chambers, which can result in the death of an animal or an entire clutch of eggs. Secondly, livestock is a significant competitor for food. Vegetation is severely overbrowsed, and the plants not consumed by livestock come to dominate large sections of habitat, where the flora has been completely degraded. The result is vegetation that is used by neither mammals nor iguanas.

The most immediate threat to the survival of *C. pinguis* is the feral cat (*Felis catus*), a very effective predator of iguanas (Iverson 1978). Each fall, when hatchling iguanas emerge from their nests, feral cats prey on the naïve iguanas, resulting in high juvenile mortality. As a result, the wild population on Anegada is made up almost entirely of older adults, with other age classes virtually absent.

In the late 1990s, the British Virgin Islands National Parks Trust (BVINPT) contacted the IUCN Iguana Specialist Group regarding the creation of a conservation plan modeled after the Jamaican Iguana headstart program. The *C. pinguis* headstart program was established in 1997, when Rondel Smith of the BVINPT found three hatchlings floating in Manhead Pond. In cooperation with the ISG, a captive facility was constructed on Anegada to serve as a safe place for hatchling iguanas to be raised. This headstart facility has expanded over the years and

currently houses over 80 iguanas. Each July, nesting females are located and their nests are marked. The BVINPT then places protective barriers around each nest. Hatchlings are collected in October and transferred to the headstart facility, where the iguanas are raised in a protective environment by the BVINPT until they are large enough to survive in the wild at relatively little risk from feral cats.

The first release of Anegada Iguanas back into the wild was designed to answer several questions: (1) What is the smallest body size at which an iguana can survive cat predation? (2) What habitat type correlates with the highest survival rates? (3) Can compromised habitat with feral livestock support additional iguanas? (4) Can iguanas adapt to living in the wild after spending the first four to six years in captivity?

Methods

Study Animals.—Forty-eight iguanas were selected from the headstart facility on Anegada during a pre-release health screening. These animals had been in the facility from four to six years. The health screenings consisted of physical exams, blood chemistry analyses, and fecal analyses. These were performed by the Fort Worth Zoo veterinary staff as part of a five-year, multi-species, health-screening project funded by a Morris Animal

Foundation grant to Bonnie Raphael and Rick Hudson. All health screenings followed the guidelines for pre-release screening adopted by the ISG.

After passing the health screening, animals underwent surgery to implant radio-transmitters. A transmitter was surgically placed in the coelomic cavity of each animal prior to release by veterinary staff of the Fort Worth and Bronx zoos. Two radio-transmitter models manufactured by Holohil Systems, Ltd. (Ontario, Canada) were used. Twelve animals were implanted with model SI-2, which weighed 9.3 g and had a projected battery life of 12–14 months. Thirty-six animals were implanted with model AI-2T, which weighed 16 g and had a projected battery life of 24–26 months. Each transmitter type provided both directional and temperature data. All transmitters were less than 1% of the average subject mass. The smaller transmitters were used in the smaller iguanas (<1200 g).

Morphometric data (SVL, tail length, mass, head width, head length, and largest crest scale length) were recorded for each animal prior to release. Animals were uniquely marked by using colored glass beads attached to nuchal crest scales. Additionally, each animal also had an identification number painted on each side of its body using T-shirt bubble paint. After a recovery period of 5–10 days, the iguanas were released into the wild.

To experimentally determine the optimal body size of head-started iguanas for release back into the wild, we released a variety of sizes (Table). In 2003, we released 24 animals ranging in mass from 750–2050 g. In 2004, we released another 24 iguanas ranging in mass from 597–1590 g. We released equal numbers of male and female iguanas at each site in both years.

Release Sites.—Each year, we released iguanas at two sites where wild iguanas were present prior to the release. Iguanas were transported from the headstart facility and released in the early morning. Each year, half of the iguanas were released on Middle Cay, one of the large peninsulas located in the western salt



Kelly Bradley manually tracking iguanas at the Faulkner study site.

ponds. The substrate on Middle Cay is eroded limestone filled with solution holes and crevices. Iguanas typically use the rock crevices and sink holes for retreats. Vegetation is mostly xerophytic thorn forest, with the principle plants being “Pokemeboy” (*Acacia anegadensis*), Loblolly (*Pisonia subcordata*), and cactus (*Melocactus intortus*) (Carey 1975, Mitchell 1999).

The second release site is the Faulkner site, located in the Bones Bight area. The Faulkner site, part of the dune system on the northwestern shore, is a coastal scrub habitat with a sand substrate. Iguanas typically dig burrows in the sand to use as retreats. Vegetation is fairly dense, and principal plants are Torchwood (*Dodonaea viscosa*), Sea Grape (*Coccoloba uvifera*), and Black Candlewood (*Erithalis fruticosa*) (Carey 1972, Mitchell 1999).

Both sites are within the remaining core iguana area and are encompassed within the Ramsar site, affording the iguanas some degree of protection. All of the animals were released in the same location at each study site on approximately the same day in

Table. Initial mass of headstarted *Cyclura pinguis* at time of release for the 2003 and 2004 study groups. Mass in g.

2003 Release				2004 Release			
Middle Cay		Faulkner Site		Middle Cay		Faulkner Site	
Sex	Mass	Sex	Mass	Sex	Mass	Sex	Mass
M	2050	M	1900	M	1540	M	1590
M	1300	M	1590	M	1340	M	1150
M	1200	M	1170	M	1040	M	950
F	1420	F	1360	F	1160	F	1160
F	1400	F	1360	F	1040	F	1060
F	1250	F	1290	F	950	F	980
M	1150	M	1250	M	760	M	930
M	1000	M	910	M	750	M	710
M	860	M	890	M	605	M	680
F	1200	F	1285	F	860	F	870
F	890	F	880	F	665	F	685
F	800	F	750	F	665	F	597



LEE PAGNI

Kelly Bradley and Glenn Gerber measure and weigh each iguana prior to release.

early October, during the peak of the wet season, corresponding to natural hatching periods when food resources are presumably most abundant.

Post-release Monitoring.—Animals were manually tracked for the first 30 days after initial release in October. Post-release monitoring trips lasting two to three weeks were made at 60 days, 120 days, 180 days, 270 days, and 360 days post-release during the first year for a total of 125 days of monitoring. Animals that have a two-year battery transmitter will also be tracked at 420 days, 510 days, 570 days, 630 days, and 720 days for a total of 204 days of monitoring.

Animals were located daily, using a YAGI antenna and a TX1001 receiver. Each time an animal was sighted, its location was recorded using a Trimble GEO XT GPS unit. In addition to manual tracking, a telemetry station was installed at the Faulkner site. The telemetry station consists of a Televit RX-900 scanner/receiver/data logger attached to four directional antennae on a 20-foot metal pole. During fieldtrips, the unit continuously records data, spending one minute on each iguana's frequency. Each time a frequency is detected, the unit records which antenna(e) responded, the strength of the signal, the pulse period relating to internal body temperature, and the time and date.

We conducted focal animal observations on one individual each day. Iguanas were observed for 45 minutes. Observation periods occurred throughout the day to determine temporal patterns. Data were collected on diet, habitat use, activity periods, and interactions with wild adults.

Virtually all animals were recaptured 60 days post-release. For each captured animal, we recorded morphometric data, body temperature, presence and location of ectoparasites, body condition, and surgical incision-site condition. Identification numbers on the animals were reapplied and glass beads reattached, if necessary. We also attempted to recapture iguanas during subsequent monitoring trips, however, iguanas quickly learned the capture techniques, and new techniques had to be used. As a result, recaptures were not always successful. At various times, we used noose poles, large fishnets, and live traps. All animals were released at the point of capture.



LEE PAGNI

Kelly Bradley and Glenn Gerber paint an identification number on a male iguana before he is released back into the wild at the Faulkner study site.

We collected all fecal deposits found in the field to document the diet and seasonal changes in diet of the headstarted iguanas as compared to the diet of wild adults. A size difference in fecal boluses from wild adults and the much smaller headstarted animals made the distinction obvious.

Results

This is an ongoing project and information presented here is only an overview of results to date. Data will continue to be taken through October 2006 or until transmitter batteries die.

2003 Release.—Sixteen months after initial release in October 2003, 83% of individuals survived. Of the four animals lost, two from each site, three were males, and all were of medium size (890–1170 g). One female was found dead on Middle Cay two days after the initial release, and the death was attributable to complications from surgery. A second mortality occurred after 60 days for reasons unknown; only the transmitter was recovered. A thorough search of the area was made, but the carcass was not recovered. This animal was the smallest male released at the Faulkner site, and also had traveled the farthest from the original release site. The last time this animal was observed alive, at the end of October 2003, it was approximately 322 m south of the point of release. Rondel Smith of the National Trust saw the animal for another two weeks, but was unable to locate it after that time.

Two mortalities were discovered during the March monitoring trip. After 195 days, the transmitter of a medium-sized



KELLY BRADLEY

Iguana no. 4, three months after release on Middle Cay of Anegada.

male was found at the Faulkner site. The transmitter appeared to be damaged by rats. We assumed that rats or large land crabs scavenged the carcass. The second mortality was another medium-sized male found in a rock crevice on Middle Cay. The animal was found alive, but in very poor shape. The animal was captured, but died on its way to the local veterinarian. This death occurred 202 days after initial release. A subsequent necropsy conducted by Shannon Ferrell, D.V.M., of the Fort Worth Zoo, showed that this animal had ample fat reserves, but significant muscle atrophy, especially along the dorsal ridge and rear legs. The necropsy clearly showed no signs of granuloma formation or inflammation associated with the transmitter. The iguana had begun to wall off the transmitter with an almost transparent membrane. No clear cause of death was established.

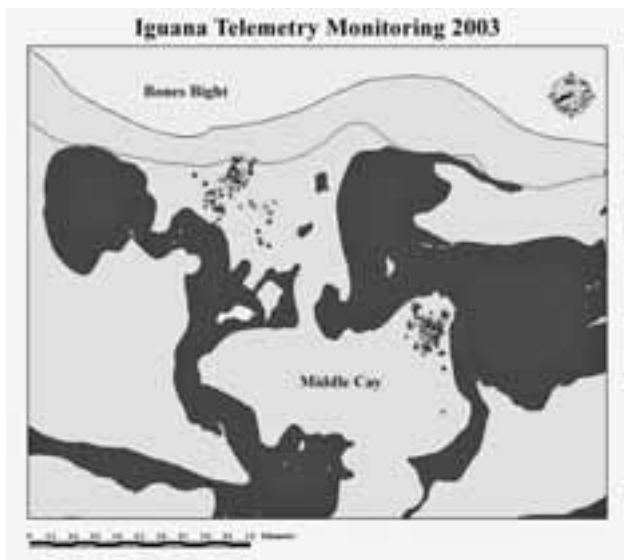
Animals at the two sites moved similar distances from the release point. The shortest and longest distances moved by animals on Middle Cay were 13 m and 391 m. The respective dis-

tances for the Faulkner site were 22 m and 322 m. The farthest distance one animal moved in a single 24-hour period was 286 m. Approximately 26 GPS points were recorded for each of the surviving 2003 animals, indicating that the iguanas had spread out evenly in their respective field sites.

2004 Release.—The second group released in 2004 has been tracked for five months with 92% surviving. One animal from Middle Cay died at 60 days. The animal was a male with a mass at release of 760 g. No carcass was found; only the transmitter was recovered. A second dead iguana was discovered on Middle Cay five months after release. This female had an original mass of 860 g. The carcass was recovered, but it had been severely scavenged. The animal was deposited at the BVINPT and will undergo necropsy at a later date.

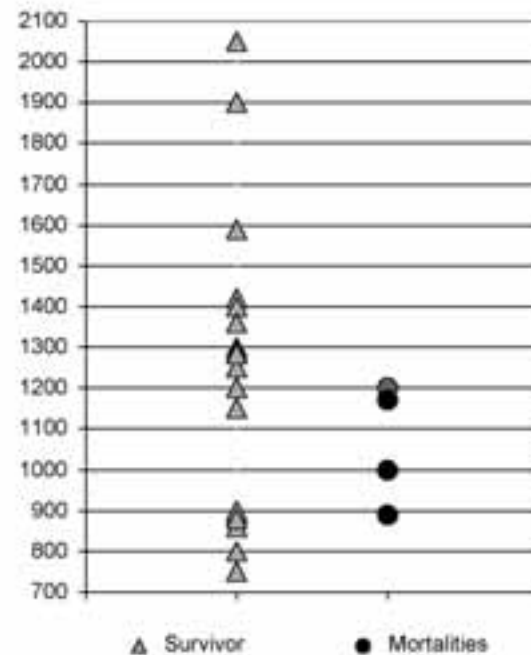
Future Plans

We hope to release a third group of iguanas from the headstart facility during October 2005. We plan to release eight animals of a smaller size class. Because the five smallest iguanas released in 2003 are still alive 16 months after release, we believe that we have not yet determined the smallest size at which an iguana can survive in the wild while exposed to potential predation by feral cats. The minimum size of the 2003 release iguanas was 750 g; the minimum size for the 2004 release was 597g. We propose to release animals with a mass as low as 450 g in 2005. By incrementally decreasing the size of released iguanas, we should be able to determine the optimum size for release. This would



Points on the map represent locations where headstarted iguanas have been sighted during the first 10 months after initial release in October 2003.

Mortalities and Survivorship of Headstartared Iguanas Based on Initial Mass



Our initial prediction was that the smallest individuals would suffer the highest mortality. Instead, iguanas of medium size died. The gray dot represents an animal that died due to complications from surgery.

enable the BVINPT to minimize an individual's time in the headstart facility, and maximize the number of iguanas being brought through the headstart facility. The information gained from this study will optimize the efficiency of the headstart program and thus bolster the remaining wild population at a maximum rate in future years.

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Author Biographies

Kelly Bradley is a Senior Research Technician for the Dallas Zoo, Reptile Department, and a Masters student at the University of Texas at Arlington. Kelly has fifteen years experience in zoo herpetology, and is a member of the IUCN Iguana Specialist Group. She has worked on field projects with Caribbean Rock Iguanas for eleven years, and became involved with the Anegada Iguana recovery project in 2001.

Glenn Gerber, Ph.D., is a Millennium Postdoctoral Fellow, Zoological Society of San Diego Conservation and Research for Endangered Species. Dr. Gerber has thirteen years of experience conducting conservation and research projects on Caribbean Rock Iguanas. He is an active member of the IUCN Iguana Specialist Group and serves on the Steering Committee.

Value-added Conservation Science: Outreach Activities that Support Conservation of the Anegada Iguana

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Photographs by the authors unless otherwise indicated.

The recovery of the Anegada Iguana (*Cyclura pinguis*) depends on the diligent work of many natural resource managers and biologists as well as a commitment from the residents of Anegada. That the species' recovery program continues to include outreach activities aimed at increasing local knowledge of and support for conservation activities should not be surprising.

“Value-added” is an economic term that refers to increasing a product’s value and thus the revenue from it. Outreach is a “value-added” activity because it increases the value of the research. Transmitting results of conservation and research programs to the public increases the conservation programs’ “revenues” or effectiveness.

Designing and implementing outreach activities on Anegada is truly a unique experience. With a total of about 100 full-time residents on the island, one can accomplish activities that reach all or most residents.

The best method for determining the direction of an outreach program is to carry out a social survey to understand the outreach needs as they relate to conservation goals. We administered a general survey on Anegada in July 2003 and a second, specific survey targeting teachers in October 2004.

The first survey assessed local support for and understanding of various conservation activities relating to the Anegada Iguana. As would be expected, 94% of the respondents (N = 34) supported the headstarting program begun in 1997. Somewhat of a surprise, however, was the strong majority of respondents (89%) who supported cat eradication. With this and other data about local perceptions of the conservation program, we developed a plan for outreach. In the last two



CLINTON "LEE" VANTERPOOL

Lee Pagni interviews a resident of Anegada for the 2003 social survey.



The first issue of the “Anegada Wildlife News” was distributed in Fall 2004. The newsletter serves the important purpose of keeping residents informed about the recovery process.



The only school on Aneгада has approximately 40 students and seven teachers.



A ZooCorps member makes sure she has the genetic sequence correct for her necklace.

years, a variety of outreach activities that support Aneгада Iguana conservation have been implemented on Aneгада and in the United States. These activities not only add value to the research, but also are ultimately vital to garnering public support for the conservation and research programs.

Acting Local

One of the most important lessons learned from the social survey was that Aneгада residents held a good deal of misinformation about the iguana restoration program. To help counter this and to attempt to inform all residents about current iguana conservation activities, we created a newsletter. Data from the survey and other interviews told us what type of information residents were interested in knowing. In August 2004, the first edition of the "Aneгада Wildlife News" was delivered to residents and schoolchildren throughout the island. The newsletter's fun design, wealth of images, and popular crossword puzzle made it a hit with locals.

The second survey, a teacher assessment given to all seven teachers at Aneгада's only school, helped us develop a plan for engaging teachers and students in conservation education activities. The second-most requested outreach activity as determined by the survey was talks by scientists for the students. To meet this need, talks have been scheduled throughout the year. In February 2004, Kelly Bradley gave a presentation to the secondary students at the Aneгада School, introducing them to radio-telemetry and its utility for understanding the habitat requirements of iguanas.

Results of the 2003 survey indicated that the headstart facility is a focal point for locals and tourists wanting to learn more about the Aneгада Iguana. In order to engage this interested audience, we developed plans to create a series of interpretive materials that allow a self-guided experience at the facility. The first sign developed was the result of a genetic study (see below) and will be integrated into other self-guided materials that explain all the activities involved in the recovery of the species.



Making a full circle connection; ZooCorps members learned about Aneгада Iguana genetic studies, then made necklaces for students on Aneгада using a sequenced gene from iguanas.



Jennie Lau of the Zoological Society of San Diego's Conservation and Research for Endangered Species (CRES) Department prepares genetic samples as part of the Aneгада Iguana genetic study.



J.J., a member of ZooCorps, works on the “genetic jewelry” that will be given to a student on Anegada.

Thinking Global

To add more value to conservation and research programs, we must remember that people living around the world are interested in programs that protect our collective natural heritage.

A grant from the Institute of Museum and Library Services helped the San Diego Zoo carry out a comprehensive genetic study on the Anegada Iguana. The study helped determine how close the relationships were among the six iguanas in the Zoo’s collection and measured genetic diversity within the wild population. The grant also helped fund outreach activities that add value to this important research.

At the San Diego Zoo, a group of 13–16 year-old volunteers called ZooCorps taught guests about the role genetic research plays in the restoration of the Anegada Iguana. Volunteers were taught about microsatellites and how these non-coding genes are used to give an estimate of genetic diversity within the population. ZooCorps members then set up a booth in front of the Anegada Iguana exhibit for two weekend days and taught guests about what is being done to protect the species. To reinforce the concept of genetics, ZooCorps members led guests in making necklaces out of four differently colored beads representing the four genetic base pairs. At the end of this program, ZooCorps members made necklaces for the



ZooCorps members made this display and used it to help explain the Anegada Iguana’s genetic status to guests.

students on Anegada, including with the necklace a personal note to the Anegadian students.

From the genetic study, an educational activity was developed to help middle and secondary school students understand more about microsatellites and how they are used to determine the proximity of relationships. This study was a collaborative effort between geneticists and educational specialists at the San



One of the goals of outreach is to involve local residents in all parts of the research. Here Camilla Serieux, a resident of Anegada, helps release a headstarted iguana back to the wild.

Diego Zoo. The lesson introduces students to concepts of genetic conservation and involves three increasingly difficult activities. The final activity relates directly to the research project and has students determine the paternity of six iguanas, given one female and two possible sires, each with a contrived set of determined microsatellite alleles at two loci. To distribute the lesson as widely as possible, it resides on the San Diego Zoo's web site (www.sandiegozoo.org) and is indexed for internet search engines using keywords such as curriculum and microsatellite.

Several other outreach activities have been developed for this project. These include a graphic panel explaining the plight of the Anegada Iguana and how genetics are being used in conservation efforts. The sign will be placed in the Anegada exhibit at the Zoo. Dr. Oliver Ryder, head geneticist at the Zoological Society of San Diego's CRES (Conservation and Research for Endangered Species) added further value to the study by presenting the results at a local event highlighting the Society's work to conserve endangered species. Finally, updated information on the project can be found on the San Diego Zoo's "Helping Wildlife" section of their website.

Continuing the Connection

This program of adding value to the conservation and research activities will continue with several activities planned this year on Anegada. In May, Kelly Bradley will deliver the gene necklaces made by ZooCorps members to students at the Anegada School. Along with the necklaces, Ms. Bradley will give a presentation on genetic research as related to the Anegada Iguana. We also are working on the second edition of the "Anegada Wildlife News." With the help of a journalism mentor from the British Virgin Islands Department of Sports and Youth Affairs, we hope to have students from the Anegada School research, write, and help produce the upcoming issue. Also this year, we will produce new

interpretive materials for the headstart facility in order to help visitors better understand the amount and type of work that is going into the conservation of the Anegada Iguana.

The Anegada Iguana recovery program demonstrates how conservation and research can be combined into engaging outreach programs. One research project, such as the genetic analysis, can serve as content for numerous educational activities and materials that help engender support for conservation locally, and patently connect others to conservation globally. Clearly, outreach adds value to conservation science and plays an important role in the recovery of the Anegada Iguana.



The Settlement is Anegada's main population center. With about 100 full-time residents on the entire island, Anegada offers unique opportunities for outreach.

GENES AND CONSERVATION

The use of molecular genetics in the management of captive populations of endangered species helps maintain healthy living collections that can become the foundation for successful breeding programs. Collection of studbook information and determination of accurate pedigrees are crucial for successful management of animals in captivity, but this information may not be available, especially for animals caught in the wild. The San Diego Zoo's collection contains three male and three female potential founders of the critically endangered Anegada Iguana (*Cyclura pinguis*), the only captive individuals of breeding age in the world. These specimens came to the zoo with questionable backgrounds. Through examination of DNA microsatellite variation, the zoo's genetics research team has been able to evaluate the relatedness of the captive population by comparing them with wild iguanas on Anegada. Based on genetic data, Apparently, of our six

captive adults, three pairs of animals are related (two of the males, two of the females, and one male-female pair), but are otherwise unrelated to one another. This information is now being used to design a captive management plan that maximizes genetic diversity in the captive collection. Future pairings will focus on minimizing reproduction among related individuals and maximizing the retention of genetic diversity within the group. In addition, our genetic work has shown that the wild population on Anegada, although highly endangered with a remaining estimated wild population of only a few hundred individuals, does not appear to be inbred when compared to other species. This finding bodes well for the future, and provides a valuable baseline for monitoring the genetic health of the wild population over time. We are grateful to the Institute of Museum and Library Services (IMLS) for funding this research.



Timber Rattlesnakes (*Crotalus horridus*) reach the northernmost extent of their range on the bluff prairies in Wisconsin.

Rattlesnakes on the Bluffs: Wisconsin Timber Rattlesnakes

Richard Sajdak¹ and Craig Berg²

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Photographs by R. Sajdak except where indicated.

The beeping kept getting stronger as I moved in, and inside my boots my toes were beginning to curl. It was my third day of radio tracking Timber Rattlesnakes, and my largest snake, a four foot male later to become famous as the Swamp Fox because of his love for a soggy patch of creek bottom, was almost certainly coiled up somewhere in the tangle of branches of a huge fallen oak tree. Over the ensuing weeks I would grow confident (and occasionally overconfident) in approaching venomous snakes hidden in tangles, but today I was nervous. — Rich Sajdak

Rattlesnakes are an essential bit of Americana, confined solely to the New World. The “*Belled Serpent*” was one of the most distinctive and frightening members of a fauna that confronted the pilgrims after their arrival in Massachusetts. Man and the rattlesnake have always had a checkered relationship — on one hand hated, feared, bountied, on the other, used as a sports logo to adorn baseball caps and once hoisted aloft by colonial militiamen over the motto, “Don’t tread on me.” Even today, in parts of the Appalachians, handling rattlesnakes as proof of faith is practiced in a few fundamentalist churches. Shamefully, in several parts of the country, rattlesnake roundups still attest to the uglier emotions the snakes elicit.

The Timber Rattlesnake (*Crotalus horridus*) is one of the largest and most widely ranging species of rattler. The Timber Rattlesnake ranged from southern Maine south through the Appalachians, along the coastal plain from Virginia to northern Florida, and westward to east Texas, Oklahoma, Kansas, and extreme southeastern Nebraska. In the Mississippi River Valley, the snake meanders north with the river into Wisconsin and Minnesota, making minor excursions along some of the larger tributaries. In Wisconsin, the Timber Rattler reaches the northernmost edge of its range, just barely below 45° N latitude, perhaps 20 miles north of historical records from Vermont and over a hundred miles farther north than current New York and Vermont populations.

Declining Populations

Ever since the arrival of Europeans, humans have been in incessant advance, the Timber in constant retreat. Originally known from 32 states and the province of Ontario, the snake has been extirpated in Delaware, Rhode Island, Maine, and Canada. It remains only in a bare handful of sites in New England. For another example, in Ohio, historical records are known from at least 20 counties, whereas current populations are known from only nine.

Beginning in the 1970s, some effort was made in various states to repeal bounties and enact protective legislation. In Wisconsin, a bounty was paid until 1973. Wisconsin bounty

records themselves highlight the rattler’s decline. In the county where our study was conducted, the number of bounties paid dropped from approximately 10,000 in 1965 to only 2,000 in 1972. Across the river in one Minnesota county, the number of bounties declined from 4,955 in 1980 to 191 in 1987.

Both of us have played a part in gaining protection for this snake. In 1973, Rich was part of the bounty repeal effort, attending public meetings and contacting people. In 1997, Craig, with David Sorensen from the Milwaukee County Zoo and Gary Casper and Robert Henderson from the Milwaukee Public Museum, petitioned the State of Wisconsin to list the snake as a “Threatened Species.” However, politics being politics, listing a venomous snake as “Threatened” was not possible, but “Protected Wild Animal” was. Discretion being the better part of valor, in 1998, the Timber Rattlesnake became a protected species in Wisconsin.

During the 1980s and 90s, one of our rite-of-spring traditions was to drive across the state from Milwaukee one day each year in mid-May, climb the bluffs overlooking the river, and revel in the beauty of the place and the returning warmth and sun after a long winter, and to see if the rattlers were still at home. Like many other rattlesnake admirers, we were aware of



Rich Sajdak searching for a Timber Rattlesnake.



JOHN SEALY AND W. H. MARTIN

The gray areas indicate the current known distribution of the Timber Rattlesnake (*Crotalus horridus*). The species occurs sparingly along some streams on the Tifton Plateau in south-central Georgia. Also, notice the narrow corridor extending north along the Mississippi River, where prime rattlesnake habitat is associated with prairie habitats on bluffs overlooking the river.

the snakes' decline, and of new roads and new building encroaching and splintering their habitat. Over the years, the visits were slowly transformed into a very low energy effort to study the snakes.

We soon realized from conversations and reading 'the literature' that next to nothing was known about these isolated upper-Mississippi River Valley rattlesnakes. Anecdotal reports, a few surveys, interviews with old bounty hunters, and extrapolation from studies by Bill Brown and Howard Reinert in New York and Pennsylvania were all we had. Bob Hay of the Wisconsin Department of Natural Resources' Bureau of Endangered Resources made it clear that, although he and others in the Bureau were concerned about the Timber Rattlesnake, limited resources and a plate full of more severely threatened species meant that funding for rattlesnake studies would remain on the back burner.

Studying Rattlesnakes

While Rich was Reptile Curator at the Milwaukee County Zoo, he put together a funding proposal to intensively study a rattlesnake population using radiolocation and tagging. The goal

was to amass the basic ecological and behavioral data on Wisconsin populations. These would be necessary for the devel-



The largest threats to Timber Rattlesnakes in the upper Midwest are loss of bluff prairie habitat and development. Notice the thick growth of Red Cedar overgrowing prairie on the point. In the last two years, five roads and over one hundred vacation home lots have been cut along the bluff tops within a mile of our study site.

opment of future conservation management plans. Although the project was not funded by the time he left the zoo, Craig took over the curatorial position, and continued to push for the study. In 1998, the Zoological Society of Milwaukee County agreed to fund the project. Craig administered the grant, and Rich became the primary researcher. During the heat of the summer, Rich was free to spend five months a year living in a ratty old trailer, climbing 600-foot bluffs every day, and dodging swarms of mosquitoes, stinging nettles, and thunder storms. During the winter, Craig had the pleasure of treading through snow, tobogganing down hills on his backside, and fending off frostbite. Heaven! Of course, as often as possible, we shared each other's joys.

With Bob Hay's help, we began our study with six snakes, two large males, two gravid females, a juvenile male, and a juvenile female captured along rock ledges in open prairie habitat on high bluffs overlooking the Mississippi River. In Wisconsin, Iowa, Minnesota, and northern Illinois, these bluff prairies are classic rattlesnake habitat, and locations favored by old time bounty hunters. Many residents are surprised to find that the rattlesnakes leave this habitat. Our study site, on an extensive tract of state land, was relatively undisturbed, with huge ravines forested with oak trees and a large area of swamp and marsh habitat along a nearby creek.

As we followed the snakes through the first year, several things soon became apparent. The two gravid females confined themselves to relatively short movements within the prairie, moving between ledges and flat rocks. These open habitats were sunny, hot, and dry, and the females used the heat to maintain body temperatures over 5°C higher than those maintained by male snakes (29.7°C versus 24.4°C). This pattern is well known in gravid snakes and is thought to help embryonic development.



Bob Hay, Armund Bartz, and Craig Berg processing a rattlesnake in the field. The snake is restrained in a clear plastic tube for safety. Length and weight are measured, the snake is sexed, rattles counted and painted, tissue sample taken, PIT-tagged, and released.



Open bluff prairies are classic snake-hunter favorites. These prairies are not only critical as den and birthing locations, but reservoirs of rare prairie plants as well.



A large gravid female regulates her body temperature by adjusting how much of her body is exposed to the sun.



A clutch of neonates lies basking at the edge of the birth rock. The snakes are less than a day old, and have not yet shed.

While the females basked in the prairie, the big males moved off the bluff into the wooded ravines to hunt. One snake stayed in the ravines, while the “Swamp Fox” moved on into the creek bottom. Both snakes preferred cooler, more shaded conditions than the females, and, rather than rocks, they were most often found touching or close to logs.

The juveniles seemed intermediate in habitat preference. They were found in or near the prairie habitat, but in oak openings: areas with more oak trees and more closed canopy. While both males moved a mile or so from their capture location, the juveniles and females moved only about a quarter mile.

As August arrived, the males became more active, and were found courting females or copulating on several occasions. The gravid snakes continued to move from rock to ledge, leaving me to wonder each time whether this, finally, would be the birthing site. At last, on the 30th, one female gave birth, followed by the other two days later, each giving birth to six or eight foot-long babies. After only four or five days, the females had abandoned the neonates and the birth site, moving over the bluff top into the wooded ravine, searching for a meal in the few weeks before hibernation.

In succeeding years, we found that hunting females, unlike gravid ones, behaved like males, moving into wooded ravines or swamps to hunt. One female required two hunting seasons to gain enough weight to reproduce again (a three-year cycle), whereas the other needed four hunting seasons (a five-year cycle). Over the years, we found that females average a three-year reproductive cycle, although we have seen cycles as short as two or as long as five years. In 2004, four of six females in our study appeared to be gravid. One of the gravid snakes had not given birth in five years. This observation suggests that reproductive events may exhibit pulses that reflect variations in weather and food supply.

By early August, all hunting snakes had reached their maximum distances from the den, and had begun a slow trek back. By early September, snakes had begun entering the den. The last to enter were the two post-reproductive females, one entering during the last week of September, and the other in early October.

Since that start in 1999, we have radio-tracked 19 rattlesnakes, tagged over 100, and located seven dens. We found

that, like their cousins in the northern reaches of the Appalachians, they have a very short activity period. Our snakes began emerging from dens in late April and May, although we have occasionally seen snakes out as early as 4 April or still in the



One of our radio-equipped rattlesnakes in classic ambush posture. Having picked up the odor of a chipmunk trail along the top of the log, the snake settles in, ready to strike as the rodent passes by. Snakes will maintain this position for days at a time.



A juvenile rattlesnake lying exposed in a rainstorm. Only extreme conditions, such as an unseasonable snowstorm, will make a hunting rattlesnake take cover.

den in mid-June. Rattlesnakes begin entering the dens in September or as late as 19 October. Oddly, Timber Rattlesnakes leave the den weeks later and enter the den weeks before Black Ratsnakes (*Elaphe obsoleta*) and Blue Racers (*Coluber constrictor*) using the same dens. Rattlers moved as much as a mile or mile and a half away from the dens. We found that, on our original study site, an extensive tract of relatively undisturbed state land, the snakes preferred hunting in oak woodland or swamp woodland habitats, and avoided entering agricultural fields or crossing highways. However, in other locations, on private land in areas closer to humans, Timbers utilized fields and even backyards, where they sometimes came to grief.

The snakes grow very slowly, taking at least seven years to reach maturity. In New York, Bill Brown has recaptured Timber Rattlesnakes he originally tagged over twenty years earlier, and believes they can approach a thirty-year life span. Our study is

not of that duration, but, based on our recaptures, one of our big snakes like the “Swamp Fox” would have to be at least 15 years old. We suspect that we will eventually confirm a life span of well over 20 years.

In years past, we had often wondered if the denning behavior of Wisconsin snakes would prove to be very different from the rattlesnakes that Bill Brown was studying in up-state New York. The northernmost populations of Timber Rattlesnakes in Wisconsin are probably reproductively isolated from those in New England. One might expect to see differences in snakes that are following separate evolutionary paths. On the other hand, the severe winters in the north are likely to be an extremely important evolutionary constraint. Similar environmental challenges are likely to yield similar results. As we learned, the denning behavior of Wisconsin snakes is almost identical to those in New York.

Table. Comparison of denning behavior in Wisconsin and New York Timber Rattlesnakes.

	Wisconsin	New York*
Earliest Emergence	6 April	8 April
General Emergence	7–21 May	7–21 May
General Ingress	14 September – 1 October	14 September – 1 October
Latest Ingress	19 October	16 October
Mean Body Temperature	10.8°C (51.4°F)(6 dens/1yr)	10.5°C (50.9°F)(1 den/3 yrs)

*From Brown (1992)



Due to its slope and exposure to the winter sun, this den is mostly free of snow even in February.



Implanting a transmitter into one of our anesthetized females at the University of Wisconsin Veterinary Hospital.

Although we do not know what the inside of a Timber Rattlesnake den looks like, a recent observation does lead to interesting speculation. Might Timber Rattlesnakes hibernate in pools of water found in the rocky recesses of their dens? During this past winter (2004–2005), we had to bring two large males into the lab. During the month of November, when they would normally be moving deeper into their dens, both animals spent a considerable amount of effort trying to push their way through the bottoms of their drinking bowls. This behavior had not been seen in two previous months of captivity. Could they have been trying to hibernate underwater?

Several tantalizing clues suggest that this might be the case. In the Pine Barrens of New Jersey, Timber Rattlesnakes do hibernate underwater. Also, Timber Rattlesnakes frequently emerge from hibernation bearing fungal sores similar to those found on Fox Snakes (*Elaphe vulpina*), another species known to hibernate underwater.

Rattlers and Local Residents

One of our biggest surprises and unexpected rewards came not from the snakes, but from local residents. We had initially

planned to keep as low a profile as possible, to avoid stirring up trouble. We had visions of some of the angry opponents we remembered from the bounty repeal and rattlesnake protection meetings deciding that a visit to the study site would end this nonsense. The problem, of course, was that our effort to keep the work secret was impossible. Also, if people don't know what's going on, they will imagine the worst — and the fact that the “usual suspect” drove a vehicle sporting New York license plates didn't help! Within a month, we heard of rumors that snakes were being moved and introduced onto private lands. The vow of silence was broken. Casual discussions revealed that, while people didn't exactly *LIKE* the snakes, they had a great deal of curiosity about them.

Additionally, we had cut ourselves off from a lot of information and help. We met several snake hunters from the bounty days, who told us about other dens and things they had seen. Likewise, they were surprised by many of the things we were discovering. Most of their work was done at the dens or nearby ledges and rocks. Rattlesnakes hunting in the woods are so scattered and so well camouflaged that these hunters, despite years of experience, knew almost nothing about the biggest parts of a rattlesnake's life. One man first said that the project was a waste of time because “lots of Timbers” were still around. A week later, he mentioned that he had been talking with some friends, and



A controlled burn: Without periodic burns and selective cutting, most bluff prairies would become overgrown with Red Cedar and Buckthorn, eliminating rare prairie plants and degrading rattlesnake habitat.



ARMUND BARTZ

Several of our radio-equipped snakes made forays into bushes and trees. Here, “Kirk’s snake” courts a pre-shed female. His head lies on top of hers.

that, while a lot of snakes were still around, many places where they used to find snakes don’t have them anymore.

Kirk soon became a friend. He showed us new locations, and joined us in tracking Timbers in the swamps and woods. In 2000, we put a transmitter into a rattlesnake that spent weeks at a time in junk piles right behind his barn. The snake became “Kirk’s snake,” and the rattlesnakes gained an advocate. Other locals would call Kirk or us if they found a snake, so we could remove it.

We have come to believe that for any conservation effort to succeed, especially those involving feared and despised species, the education and support of local residents is an essential component. Just last year, we heard about a school bus full of kids that came upon a Timber Rattlesnake crossing the road, a sure recipe for a dead snake in past years. The kids and driver got out to see if it was one of our study snakes, which have painted rattles. They let it crawl off to bask another day. Now that’s success!

Acknowledgments

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Hay, John Kivikoski, Armund Bartz, and many others contributed gallons of sweat and many days in the field. Lester Flick provided hard-won experience. Kirk Holliday gave us his time, sweat, good will, and home. Rich’s wife, Linn, was long-suffering and always supportive.

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Blue Iguana “YOB” (bead tag: yellow-orange-blue), moments after release back into the wild after being fitted with a PIT-tag, bead-tag, and radiotransmitter.

Blue Iguana Update

Frederic J. Burton

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Photographs by the author.

“Team Blue 2005,” a rotating team of international volunteers, is in the midst of an ambitious field season working with the Blue Iguana Recovery Program on Grand Cayman. As the Grand Cayman Blue Iguanas (*Cyclura lewisi*) reach the peak of the annual mating season, program staff and the Team Blue volunteers are capturing and attaching radio transmitters to wild Blue Iguanas in the deep interior of Grand Cayman’s East End, and to 23 captive-bred Blues released in December into the Salina Reserve, a protected area in north-eastern Grand Cayman.

The work in the Salina Reserve builds on two months of radio-tracking that commenced immediately after these iguanas were released. At that time, they were still subadults. Now, in May, they have grown to the point that some at least appear to be in breeding condition, and aggressive interactions are driving the males into the rocky shrubland surrounding the small soil patches where we hope the females will nest.

The elusive remnant wild population in the eastern interior is only slowly revealing its secrets to diligent observers. In previous years, this has been the only known site where unmanaged wild iguanas still appeared to be breeding. Very few individuals



Male iguana (green-red-blue) receiving a pit tag.

seemed to be involved, with possibly only one nest per year — but the nest site(s) and the locations of the breeding adults were completely unknown. This year for the first time in many years, no new young have appeared in this home of the last wild Blues. Most likely, all were drowned in the nest during the floods that accompanied Hurricane Ivan last year.

Team Blue members struggled to make the first contact, but in late April eventually managed to trap a young but mature male, who was bead-tagged Green-Red-Blue (GRB), fitted with a radio transmitter, and released. Over the next two weeks, twice-hourly triangulations of his position showed him spending most of his time in six small areas within his large home range, providing the team with indications as to where they should focus their efforts. Using blinds at these locations, two more wild iguanas were first spotted, and then eventually, on 9 May, these also were trapped and radio-tagged. One was a young mature female, laden with eggs, the other a young male scarred from fights, probably with GRB. The female (tagged Green-Green-Red) and the second male (Yellow-Orange-Blue) are now also being tracked by triangulating their radio signals throughout each day, hopefully leading the team to more wild Blues, and to their nesting sites in June.

By the end of June, the Blue Iguana Recovery Program hopes to be incubating eggs from these wild iguana nests, as well as from nests in the Salina Reserve and from the released and captive populations in the QE II Botanic Park.

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Team Blue 2005 volunteers (left to right) Ae Nash, Nick Louis, and Lorraine Scotson carrying YOB back to the site of his capture.

Hellshire Blues

Rick Hudson

Fort Worth Zoo, Fort Worth, Texas 76110

Whenever I take someone to the Hellshire Hills in Jamaica to see the iguana field project, I describe the habitat as someplace where they definitely don't want to fall down. The brutally sharp limestone rock, known as karst, can inflict grievous bodily harm to someone unfortunate enough to take a tumble. However, after seven years of trekking around Hellshire without serious injury, I took that tumble in June 2000, when we had gathered a field team to search for new nesting areas. I was wearing a new pair of boots and not at all confident of my stride. Without my "field legs," I predictably stumbled and hit the uncompromising karst with both hands and knees. Deep puncture wounds in the heels of each hand plus some nasty knee injuries kept me laid up in the hammock for a day recuperating and ingesting pain pills and anti-inflammatory drugs. Although it could have been a lot worse, to this day I wear thick leather gloves when traversing the karst of Hellshire. That way, if I feel myself going down, I can at least break my fall with my hands without risking serious injury.

As painful as that day in 2000 was, it absolutely does not compare to the indignity suffered on my recent February 2005 trip. A record (my personal) three iguana bites over three days, combined with walking out of Hellshire in the dark (which can be dicey even in broad daylight), topped off by getting mired past my knees in swamp mud, all resulting in what I consider my roughest trip yet. Maybe not the roughest physically, but certainly the most damaging to my psyche.

The misadventure began at the Hope Zoo in Kingston, home of the Jamaican Iguana headstarting program. We were preparing another cohort of 16 iguanas for repatriation into their native habitat, and I was joined by a veterinary team from the Fort Worth Zoo plus two Ministry of Agriculture veterinarians. During the next three days, we would be conducting pre-release medical screening exams on 22 mid- to adult-sized iguanas to certify them healthy for release. This includes weighing and measuring, collecting blood and cloacal cultures, physical exams, and attaching bead tags for visual identification in the field. My job was to restrain the iguana during much of this process, which is something that I have done so routinely that it has become *second nature* — or so I thought. The first bite on my right thumb from a small female was minor; I covered the wound with a band-aid and we were underway again in no time.

The next day, with our performance under the glare of a graduate biology class from the local University of the West Indies, I sustained my second bite. With a hood over the iguana's head and eyes to relax it, and using a rather cavalier one-handed restraint, I somehow managed to pass my left hand in front of the iguana. With a quick lunge and shake of the head, I had a perfect, U-shaped bite on top of my hand that was bleeding pro-

fusely. I took this latest injury in stride and began trying to staunch the flow of blood. The class was amused, except for one student who couldn't handle the sight of blood and had to leave the building. Fortunately, the veterinary team was amply prepared with a range of first-aid supplies, and Veterinary Technician Kim Evans dutifully (again) bandaged my wound. No band-aid was adequate, and, for the rest of that trip, my hand was bound in green veterinary wrap.

However, the clincher came on Friday, 25 February, our first day in Hellshire. With eight pairs of iguanas in hand, we hit the beach at Manatee Bay around noon and set up camp. Around 4 PM, three of us (field biologist Rick Van Veen, Kim, and me) decided to make the trek to South Camp to release a few males. We tend to release males in a somewhat random manner in order to disperse them in hopes of reducing conflicts. In contrast, females are always released at one of two primary nesting sites so that they have an opportunity to imprint on the



KIM EVANS

This iguana bite would later seem insignificant, but only two hours later we were mired deep in the mud and muck of a "dried-up" salina. The word "salina" means swamp, but is designed to avoid a sense of dread. Don't be fooled; if you hear this word, and it involves your walking through it, be very afraid.



KIM EVANS

Nothing is capable of consoling a person who has just emerged, iguana-bitten, beaten down, and exhausted from a night of wandering in a swamp — but an ice-cold Red Stripe was about as welcome a sight as any I could have imagined. Now that's proper planning!

area in case this becomes important later. So, with the sun low in the sky, and with the full realization that it would begin setting in two hours, we began our ascent into Hellshire. To lighten my load, I had removed most non-essential field gear — including a headlamp that had to weigh all of eight ounces. What a relief that was! After reaching South Camp, we caught our breath, had a drink of water, and started unbagging the males for release. These were all large adult males, well within breeding size. Whether it was a lapse in judgment, carelessness, or just a slip of my hand, I somehow managed to allow one of these big boys to clamp on to my right thigh, way too high for comfort. To make things worse, he didn't just lunge and bite, he held on with a tenacity that I thought was reserved for wolverines and alligator snappers. Registering pain beyond anything iguana-related I had previously experienced, and with blood streaming down my leg into my boot, I issued an expletive-laced cry for help. Rick was quick to respond, but not in the way that I had expected: between bouts of wicked laughter and mumbling about not having batteries for his flash, Mr. Van Veen (formerly known as my favorite Aussie) searched for his camera. He couldn't resist the urge to catch the famous iguana man in such a compromising situation. Kim busied herself finding the first-aid kit, and extracted some cotton balls and a few band-aids. Fully expecting a gaping flesh wound in need of suturing, I thought to myself "that ain't gonna cut it, honey; you better look for

some #2 cat gut." Rick had finally managed to stifle his laughter and began the task of trying to extricate the iguana that was so intimately involved with my upper thigh. Each attempt to loosen the jaws would produce another chomp and another surge of intense pain. With Kim working the back and Rick the head, he finally managed to pry the jaws loose. First aid included application of some primitive foul-smelling wound dressing that Rick had in camp (I remember something like Dr. Percival's bitterroot swamp tonic) followed by an elastic bandage. With this unexpected event taking up valuable time and the sun quickly setting, we released the four males and began heading back to camp. Only halfway there and visibility was already extremely poor; three-fourths of the way and the three of us had to hold hands to stay in contact as we maneuvered the rocky trail. I lamented not bringing my headlamp, to which Rick replied: "If I'd thought of it, mate, I could have brought one from South Camp." Although I wasn't sure what an aneurysm felt like, I was pretty sure I was about to add that to my list of the day's maladies. My only comment to Rick was that killing his primary sponsor and #1 champion for his project was not a good career advancement strategy.



When we finally reached a point where continuing on the trail was becoming hazardous, and facing a final stretch to the beach that meant stepping from one large boulder to the next, we opted to walk through the "dry" salina. With no tree canopy to block the new moon, the salina was better lit but no more hospitable. Kim and Rick would leave shallower footprints than my 210-pound bulk, but they were already sinking to their ankles. Not long thereafter, I punched through and began sinking. Once the mud goes past your knees, any hope of an unassisted escape is gone, and, on at least three occasions, I had to be unceremoniously extracted from the swamp (I'll never call it a salina again) — only to take a few steps and sink again. Something about crawling helplessly in the mud is very humbling — and I can say with absolute certainty that I never want to feel that humble again.

HUSBANDRY

Captive Care of *Uromastix*¹

Thomas Wilms

Bad Dürkheim, Germany

Photographs by the author except where noted.

Recommendations for Purchase and Acclimation

Ideally, one should acquire captive-bred animals directly from a breeder. These animals are already accustomed to humans and tend to be free of pathogens. Most breeders also are willing to provide helpful advice on how to care for young *Uromastix* and continuing support should any problems arise later. In contrast, wild-caught animals are usually highly stressed by capture, transport, and handling by retailers. They often are suffering from illness, parasites, and dehydration. Sick animals often have sunken eyes, jutting pelvic bones, muscle wasting of the tail and extremities, and poor color. However, regardless of the source from which the *Uromastix* is purchased, the following ground rules should be followed:

1. The *Uromastix* should be alert, moving normally, and interested in proffered food. Newly imported *Uromastix* display obvious defensive reactions when handled. Obviously “tame” behavior in a recent import is an indication of possible illness. Missing toes and tail tips are usually not a problem; however, any injuries should be well healed.
2. The animals should not have any signs of infection, abscesses, or burns on their bodies, extremities, or tails. Special attention should be paid to skin folds. Mites are known to inhabit skin folds of the neck and limb insertions as well as the areas around the eyes and in ear openings. Limbs should not exhibit any swelling. *Uromastix* tend to have shedding problems, particularly on the spiky scales of the tail. No old skin layers should be present anywhere on the body.
3. The mucous membranes of the mouth should not exhibit any injuries, crusting, or infection. Under no circumstances should any parasites be visible in the mouth and the breath should not smell unpleasant.
4. Eyes should be clear. Nasal openings should be dry and without mucus discharge. Nasal glands may produce a watery salt solution, which, when dry, forms a white salty crust around the nasal openings.
5. The animal should appear properly nourished. The base of the tail should not be concave and pelvic bones should not be obvious.
6. Breathing should not be labored. Any whistling, coughing, or sneezing can be an early sign of illness. Note, however, that even healthy *Uromastix* will sneeze occasionally to expel excess salts (see point 4 above).

An important first aid measure for animals with sunken eyes, jutting pelvic bones, muscle wasting, and poor color is rehydration. A daily dose of 20–30 ml of a physiological electrolyte solution (e.g., Pedialyte® or Gatorade®) per kg body weight should be administered orally. Opening the animal's mouth may present difficulties. Under no circumstances should it be forced. If oral administration is not successful, the alternative is to have a veterinarian inject subcutaneously (under the skin) a sterile electrolyte solution. If the animal refuses food for an extended period of time, an easily absorbed formula such as Critical Care® or Ensure® with added fiber can be administered orally (50 cc/kg body weight daily, divided into three to four meals spread out over the course of the day). Sustained force-feeding can lead to further problems; any animal that does not start eating independently within a day or two should be seen by a qualified reptile veterinarian.



Uromastix: Natural History – Captive Care – Breeding by Thomas Wilms (142 full-color pages, hardcover, 138 color photos, 23 drawings, and distribution maps for every species). Price: 39 EUR. Offenbach: Herpeton, 2005 (www.herpeton-verlag.de). ISBN 3-936180-12-1.

This book provides detailed information about all species in the genus *Uromastix* and addresses all topics relevant to the hobbyist, professional herpetologists, and veterinarians.

Contents: Name and systematics, distribution and zoogeography, habitat and natural history, behavior, captive care, reproduction, raising hatchlings, skin diseases, an identification key to all species of *Uromastix*, accounts of all species, and more ...

AVAILABLE AT BIBLIOMANIA (breck@herplit.com)

¹ Translated and adapted by AJ Gutman from T. Wilms, *Uromastix: Natural History – Captive Care – Breeding*. Herpeton Verlag, Offenbach, Germany.



JOHN BURNS

A healthy seven year old *U. acanthinurus* female receives regular exposure to natural sunlight, weather permitting.

Regardless of origin, a newly acquired *Uromastyx* should be quarantined for 6–8 weeks in an easily cleaned habitat. Even though the quarantine habitat is only temporary, the various psychological and physiological needs of the animals must still be met. Temperature must be properly regulated and hiding places provided so that the animals feel secure. During the quarantine period, stool samples should be taken repeatedly and checked for parasites. These should also be cultured for amoebas. A sick *Uromastyx* should always be seen by an experienced reptile veterinarian; self-treatment is not recommended.

The minimum terrarium dimensions for a pair of *Uromastyx* are 5 x 4 x 3 (L x W x H) times the snout-vent length (SVL) of the animals. Thus, for an SVL of 25 cm, the minimum dimensions would be 125 x 100 x 75 cm. In my opinion, these dimensions represent an absolute minimum, but other parameters also play a significant role in providing species-specific care for *Uromastyx*. These considerations include: population density, social structure, terrarium setup, climate, lighting, and nutrition.

Population Density and Social Structure

Adult male *Uromastyx* are territorial and intolerant of sexually mature males of the same species. Adult males should never be kept in the same terrarium. Even females, especially when gravid, can be highly intolerant of each other. *Uromastyx* are best kept in pairs. In many instances, a lower ranking animal will become so stressed by the mere presence of a dominant animal that it will refuse food and cease to exhibit any normal activity. These animals grow slowly, if at all, and are susceptible to bacterial and parasitic infections. Eventually, fights will break out, which, within the confines of a terrarium, can result in damage. Injuries from bites to the toes, tail, and flanks as well as broken extremities can be largely avoided by keeping animals in pairs. Aggression between males and females is much less common. If this occurs, the animals should be placed with different partners. Occasionally, some individuals will display consistently high levels of aggression and must be kept by themselves. In smaller terraria with a high population density, fighting and biting among all species is inevitable. Animals in very small terraria with very high population densities demonstrate virtually no natural behavior. They are unable to claim any territory and give the external appearance of being compatible and “tame.” In the past, this led to the belief that *Uromastyx* are social creatures, which should

be kept in groups. However, such animal husbandry does not conform to the biology of the animals and is strongly discouraged. Juveniles should never be kept with adults!

In principle, keeping *Uromastyx* with other species with similar ecological requirements is possible, if enough space is provided. Some examples of suitable species are the Hardun and relatives (*Laudakia* sp.), Fringe-fingered Lizards (*Acanthodactylus* sp.), and Middle Eastern Agamids (*Trapelus* sp.). Keeping different species of *Uromastyx* together is not advisable. The behavioral repertoire of the various species is so similar that cross-breeding between species can occur. Crosses between *U. aegyptia* males and *U. acanthinura* females as well as between *U. acanthinura* and *U. dispar maliensis* are known. Hybridization within a genus is possible; however, to date, hybrids between *U. acanthinura* and *U. dispar maliensis* are known only from captive breeding situations.

Setting Up the Terrarium

Commercially available glass terraria can be used for keeping young *Uromastyx* or species that remain small. However, these do not provide sufficient space to house adult animals of most species. In general, a *Uromastyx* terrarium must be custom built. Laminated wood or plastic boards can be used in combination with glass. Even when used for a desert habitat, wood should be sealed against moisture. Any materials used inside the habitat should be as durable as possible. Large knotted branches as well as natural or artificial rocks are suitable.

The habitat should be structured to provide visual barriers for the animals. Natural or artificial rock can be used to create caves and tunnels. A hide-box can be used or the habitat can be set up with a double floor. As a safety precaution, any cave or hide-box should be high enough that the animal’s back will touch the roof when reclining conventionally. The interior should also be large enough for the animal to turn around comfortably. All stone structures should be securely attached, although caves and tunnels should be accessible to the caretaker at all times.

With a little crafting skill, you will be able to create your own artificial rock. A technique that works well for this type of



Healthy male *Uromastyx acanthinura nigriventris*.



Combat between a pair of male *Uromastix acanthinura nigriventris*.

application involves gluing sheets of styrofoam to the back and/or side walls of the terrarium. These can then be modeled to form hiding places and caves. The resulting styrofoam “rockscape” can then be plastered with modeling cement. While still soft, the cement can be colored by stirring in readily available paint emulsions. To avoid cracks, I use a preservative coating, which leaves the cement far more durable and resistant to crumbling. The surface of the cement can also be modeled with a brush while it is still wet and subsequently strewn with sand. Once dried, this produces a hard surface with plenty of traction for the animals. In my opinion, an external coating of epoxy is not necessary in a dry terrarium.

Hiding places allow the animals to fulfill their need for concealment. Without an appropriate retreat, a *Uromastix* will feel insecure and react to even the slightest disturbance with hectic flight. Wild caught individuals are much more difficult to acclimate without a secure hiding place. Natural sand mixed with clay makes the best substrate. Pure quartz sand is not suitable. A depth of about 5–6 cm of substrate is sufficient if artificial caves and tunnels are present. If you are not using prefabricated caves and tunnels, the animals should have the opportunity to create their own. This requires a substrate at least 25 cm deep and in which they can dig.

Aside from housing *Uromastix* in a conventional terrarium, they can be maintained in a heated green house, which could



Juveniles, such as this *Uromastix dispar dispar*, should be raised separately from adults.

provide the animals with nearly optimal light and heating conditions. An open terrarium can be built on a podium approximately 80 cm high. The glass surfaces of the green house should be made of Plexiglas panels which are UV-penetrable.

Climate

The two most important climate parameters for keeping *Uromastix* are temperature and light intensity that approximate natural seasonal fluctuations. The ambient temperature during the animals' activity period during the day should be from 28–40 °C, in exceptional cases to 45 °C, and from 18–20 °C at night. Basking spots with a localized temperature of 50–60 °C should also be provided. Heating for these basking areas is best provided by radiant heat sources. Emitters should provide both heat and light in the visible spectrum. Pure heat emitters, such as infrared lights or “hot rocks” are not appropriate. *Uromastix* are heliophilic (sun-loving) and associate warmth with light. “Dark” basking spots do not meet the physiological requirements of the animals. In my experience, many *Uromastix* species are better kept too cold than too warm.

For appropriate maintenance of species such as *U. aegyptia*, *U. acanthinura*, and *U. hardwickii*, a brumation period at reduced temperatures is necessary. In the wild, these species can be seen outside their burrows during warmer weather. A brumation period in the terrarium is introduced by a gradual low-



Gravid female *Uromastix thomasi* in front of her retreat.



Part of the author's terrarium setup devoted to *Uromastix*.

ering of temperature to 15–20 °C and a reduction in photoperiod and lighting intensity. Throughout the brumation, the animals should have the opportunity to warm themselves to preferred temperatures under a heat emitter. This heat source should be in operation for about 6–8 hours, and the remaining lighting should be operational for about 10 hours per day. If maintained in a greenhouse, species requiring a brumation period should be kept at a temperature of at least 15°C. On sunny winter days, the air temperature can reach values over 20 °C through sun exposure. Also in a greenhouse situation, depending on the weather, heat emitters should be in operation for 6–8 hours a day from mid-September until the end of March.

In the terrarium, the duration of the brumation period is 2–4 months for *U. acanthinura*, 3–4 months for *U. aegyptia*, and 4 months for *U. hardwickii*. For species with no significant annual temperature fluctuation, a slight reduction in temperature during the winter is sufficient. For *U. dispar*, *U. thomasi*, and *U. ornata*, experience has shown that a maximum temperature reduction of 5–10 °C is sufficient to encourage reproduction. Other species in this category include *U. princeps*, *U. benti*, *U. ocellata*, and *U. macfadyeni*. When maintained in a greenhouse, even winter temperatures must correspond to natural conditions within the range of each species. In addition, lighting must be provided in the terrarium.

Although *Uromastyx* are acclimated to life in desert and semi-desert regions, a minimum of humidity is necessary to maintain them in captivity. In the wild, the animals will spend a significant portion of the day in their burrows, where the moisture content of the air and the surrounding ground is somewhat higher than that on the surface. The humidity requirements also

differ according to species. Species originating in extremely arid inland deserts are considerably more tolerant of dryness than species from coastal mountains. Climate tables for each species' point of origin should be consulted. An occasional misting can increase the humidity within the terrarium; juveniles should be provided with a water dish. However, water build-up in the terrarium should be avoided, as this is a known cause of many of the skin diseases that occur in various species of *Uromastyx*.

Lighting Conditions

Lighting in the terrarium should vary seasonally and correspond with the length of the natural photoperiod. In general, a duration of 12–14 hours of light per day in the summer and 8–10 hours per day in winter is beneficial. Fluorescent tubes, mercury vapor lamps, and metal halogen lamps are all suitable for illuminating the terrarium. In a terrarium of up to 65 cm in height, the desired lighting intensity (without heat emitters!) should be about 100–120 W/m². In principle, a *Uromastyx* terrarium can never have too much lighting, and it tends to be limited only by financial constraints.

The use of appropriate UV lighting is critical for maintaining *Uromastyx* species. Apart from critical UV rays, the heavy illumination will also positively affect the activity levels and overall well-being of the animals. The distance between the light and the animal will vary depending on the lighting products used; however, the animals must be able to withdraw from proximity to the light if they become overheated. Mercury vapor bulbs such as T Rex's UVHeat and Zoomed's Powersun UV can be operated all day long to provide both heat and ultraviolet light. Specially designed fluorescent tubes also can be used to provide UV (e.g., Zoomed 5.0 Reptisun). In order for these tubes to be



Retreats are important for providing humidity. This *U. acanthinura* guards the entrance to her self-excavated below-ground retreat (bottom left of photo).



Lighting in a terrarium for *Uromastyx* should be fairly intense.

effective for desert reptiles, the animals must be in fairly close proximity to the bulbs. In my opinion, the bulbs should be installed in the terrarium so that they are no more than 20 cm above the basking sites.

Nutrition

A well-balanced and varied diet is critical for maintaining and breeding *Uromastyx*. The species of this genus are omnivorous, with plant matter making up the largest dietary component. Juveniles often prefer animal nutrition; e.g., the diet of juvenile *U. acanthinura* in the wild consists of approximately 75% animal source components. Remnants of tenebrionid and carabid beetles, ants, and grasshopper larvae have been found in the stomachs of young *U. aegyptia*, but animal materials constitute only 1–2% of the total food intake in these lizards.

Plant matter should be offered daily, but with one or two fast days per week. In the winter, escarole, collard greens, romaine, and other leafy greens are available as well as parsley, grated carrots, and sprouted mung beans, lentils, wheat, sunflowers, and other seeds. During the growing season, a wide variety of wild plants should be fed. Apart from common Dandelions (*Taraxacum officinale*), Narrow- and Wideleaf Plantain (*Plantago lanceolata* and *P. major*), as well as several clover species (*Lotus* sp. and *Trifolium* sp.) are eagerly consumed. Both the plumed leaves and the flowers of vetches (*Vicia* sp.) are prized, as are the leaves and flowers of Robinia (*Robinia pseudoacacia*). The animals can also be offered composites (including Hawkweed, *Hieracium* sp.; Goatsfoot, (*Senecio* sp.; various Dandelion species, *Leontodon* sp.), convolvules (including Bindweed, *Convolvulus sepium* and *C. arvensis*), and carnations (including Chickweed, *Stellaria media*). Other appropriate food plants are daisies, alfalfa, coltsfoot, borage, dill, chervil, lovage, rosemary, sage, sorrel, and lemon balm. Various species of grasses and their seeds also may be offered.

Uromastyx also should be provided with a mixture of dried seeds and beans made up of green and red lentils, small grain corn, small green peas, barley, wheat, soybeans, vetch, oats, rice, hemp, mung beans, sunflower seeds, buckwheat, and millet. This dry food mixture should be constantly available.

Fruits are rarely or only occasionally consumed and should generally not be included in the menu. Food plants can be fed

whole or chopped into smaller pieces and strewn on the bottom of the terrarium. Food remnants can actually be left in the terrarium, as the animals often prefer dried leaves to fresh ones. In this case, you do need to be careful to avoid the development of rot or fungus.

Apart from this vegetable matter, *Uromastyx* can be fed various insects such as cockroaches, grasshoppers, wax worms, crickets, beetle larvae, etc. Juveniles can be fed insects 4–7 times per week, whereas adults should only receive them once or twice a week.

The composition of the diet should vary throughout the year. In the wild, certain foods are accessible only at certain times of year. Due to the meager and highly seasonal precipitation in their natural habitat, fresh plant material in the form of herbaceous annuals (so-called therophytes) is usually available for only a short time. Most of the time, *Uromastyx* survive on the few perennials plus seeds. In captivity, the dietary proportion of wild plants and sprouts can be increased either following brumation or in the spring for species without a clearly defined seasonal rhythm. At this time, the proportion of animal-based foods in the diet can be increased. Females in particular have an increased protein requirement in order to produce eggs. During mid-summer, the dietary proportion of seeds can be increased. Through seasonal changes in dietary composition and climate regulation, the animals are further encouraged to maintain their natural annual rhythm. During brumation, very little food is consumed. However, fresh drinking water must be available during this period.

To ensure that vitamin and mineral requirements are properly met, various supplements can be used. Combined vitamin and mineral preparations (e.g., Miner-al™, Nekton Rep™, Rep-cal™, etc.) can be used to dust food insects. However, an appropriate mineral supplement should also be mixed in with seeds. Certain preparations can easily be sprinkled on plant food, while others produce a slimy, foul-smelling film and should not be offered to this species in this manner. Fluid vitamin preparations should be administered to each animal individually.



Sprouted seeds make an excellent addition to the diet of this female *U. ocellata*.



Juvenile *Uromastix thomasi* at the age of six months.

Unfortunately, no guidelines for vitamin dosages are available for *Uromastix*.

Life Expectancy

To date, little information is available on the life expectancy of *Uromastix* species. Due to the relatively late onset of sexual maturity in many species (*U. acanthinura* at 4–5 years of age, in *U. aegyptia* at 4–6 years), a certain longevity is expected. So far, the shortest time span to onset of sexual maturity in a *Uromastix* species is 11–18 months (*U. ornata*).

Life spans have been recorded for *U. aegyptia* (15 years, 4 months), *U. acanthinura* (11 years, 5 months), and *U. ocellata* (3 years, 9 months), and all individuals were still alive at the time of the report. I had a *U. benti* that was imported as an adult that survived for 7 years and a female *U. ornata*, also an adult import, that is still alive after 10 years. A *U. asmussi* that was captured as an adult on 9 April 1954 lived until 23 October 1960, and a *U. acanthinura* survived for 13.5 years in captivity. That this is considerably less than the maximum life expectancy for species of *Uromastix* is demonstrated by a *U. acanthinura* that was kept for 22 years. This particular animal, which was imported as a subadult, remained in the best of health when the report was made. Yet another *U. acanthinura*, imported as an adult in 1973, survived until 1995.

The presumed longevity record within the genus is held by a *U. aegyptia* living in the wild in Israel. The age of this animal was estimated to be at least 33 years. The animal was captured on 15 June 1980, measured and marked, and recaptured on 19 March 1994. The total length during these 13 years and 88 days increased from 4.3 cm to 74.3 cm. The age estimate is based largely on the calculated growth rate.

Acknowledgments

A. A. Schmidt (pers. comm. 1995) provided longevity records; D. Dix (pers. comm. 1999) provided information on hybrids between *Uromastix acanthinura* and *U. dispar maliensis* in captive breeding situations; and H. Leslie (pers. comm. 2000) informed me of the onset of sexual maturity in *U. ornata*.

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Author Information

Thomas Wilms is a biologist who has worked with *Uromastix* for over 15 years. He has successfully and repeatedly bred many species and the hatchlings often become subjects of new research projects. Wilms also has traveled widely in the natural range of *Uromastix* lizards, where he discovered a new species and where observations of wild-living populations have effectively supplemented his laboratory studies.

PROFILE

The Artist as Iguanaphile: A Profile of Joel Friesch

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I'm not sure how many iguanaphiles can boast of having fabricated the suit for RoboCop II, or being the visual effects supervisor on Cat Woman, but Joel Friesch can (not that he boasts — he doesn't — and, yes, he met Halle Barry).

I've known Joel Friesch for 20 years, and his artistic talents continue to amaze me. Our paths first crossed in the Milwaukee Public Museum in the mid-1980s when Joel, as a fine arts (painting and drawing) student at the University of Wisconsin-Milwaukee, was hired to model and paint amphibians and reptiles for a permanent exhibit on rainforest ecology. As it was my responsibility to oversee all aspects of the exhibit concerned with herps, Joel and I had many interactions. During the multi-year production of the exhibit, Joel intimated that his supervisor

wanted him to enhance the color of some of the critters to make them more eye-catching. He told me he'd only paint them the way I wanted them done. I was, of course, impressed with his devotion to accuracy.

We had some live giant Hispaniolan treefrogs, *Osteopilus vastus*, for the exhibit. On his own time, Joel carved and accurately painted a model of this neat frog about 50 times life size. On the night the exhibit opened, he had fastened it to a wall of the exhibit and we enjoyed watching visitors' surprise as they



Joel painting "Mugwumps" for David Cronenberg's movie *Naked Lunch* at Chris Walas, Inc. in the 1990s.



Joel clear-coating a model of a Burmese Python (*Python molurus molurus*) modified and painted to look like a Green Anaconda (*Eunectes murinus*) at the Milwaukee Public Museum in 1987. Photograph courtesy of the Milwaukee Public Museum.



Joel painting reptiles with Jerry Persick for a rainforest exhibit at Milwaukee Public Museum in 1987. Photograph courtesy of the Milwaukee Public Museum.



Treefrog (*Osteopilus vastus*) sculpture (above Joel), circa 1986-7. This sculpture now hangs in the home of the author. Photographer unknown.

realized what they were seeing (that giant frog now resides in my living room, a gift from my wife who bought it from Joel). Joel came to the museum already enamored of iguanas. He had two between 2nd and 5th grades, but was forced to donate them to the Milwaukee Zoo because his parents felt they were “too big” for him. Because we had to purchase some live Green Iguanas in order to make detailed models for the exhibit, Joel asked me to order two juveniles for him. I don’t think Joel has been without iguanas since.

I knew Joel’s goal was to work in the movie industry as a special effects artist. I had hoped he’d stay at the museum, but showbiz beckoned; shortly after graduation, he headed for California. Not surprisingly, success in the movies came fairly quickly. He free-lanced for Disney and other studios before assuming a permanent position with Tippett Studios in San Francisco. As luck would have it, just as Joel was beginning his career in the movies, the movies were in the process of going

almost exclusively to computer-generated special effects. Joel learned the new techniques on-the-job, and he has graduated from an animatronics technician on “Arachnophobia” to visual effects supervisor on the forthcoming “Charlotte’s Web.” Between his spider pics, Joel has worked on “Naked Lunch,” “Nightmare Before Christmas,” “Mission to Mars,” “Cat Woman,” and “Hellboy,” to name a few. He also has done lots of commercials, winning a couple of Clio awards in the process.

A few years into his “Hollywood” career, Joel called and asked when I was heading out for my next field trip and could he come along. I was heavily involved with treeboas (*Corallus*) by then, and making regular trips to Grenada. In 1993, Joel made the first of his treeboa trips. I knew he’d be low maintenance in the field: hardworking and no complaining. However, he went a step farther by bringing along a supply of Pop Tarts for breakfast to offset the monotonous menu of peanut butter sandwiches. Joel was fearless in the field: he’d climb trees I was no longer agile enough to ascend myself, and he always wanted to capture the biggest treeboas. I can recall his first shot at capturing a large female (uh, treeboa). It was perched low under some shrubbery and Joel had to stoop low to get a good angle on it. Once you commit to grabbing one, you can’t hesitate ‘cause they’ll nail you. Joel hesitated and Joel got nailed. He yelped and bled, but he



Joel participated in the 2000 Shedd Aquarium trip to Andros Island, Bahamas; shown here with the first capture of an Andros Iguana (*Cyclura cyblura cyblura*).



A portrait of “Billy” (Grand Cayman Blue Iguana, *Cyclura lewisi*) as Joel first saw him at the breeding and headstarting facility on Grand Cayman.



CATHY FRIESCH

Joel and his son Mason in the “RWH Cyclurium” holding “Andros” (Rhinoceros Iguana, *Cyclura cornuta*) with “Duke” (Grand Cayman Blue and Cuban Iguana hybrid, *Cyclura lewisi x nubila*) on the other side of the screened cage.



JOHN BINNS

Joel was an IRCF team member refurbishing the Anegada Head-starting Facility in 2001.



JOHN BINNS

Joel receiving hugs from “Dino,” John and Sandy Binns’s Black Throat Monitor (*Varanus albigularis ionides*) in 2001.

caught the snake. Subsequently, Joel made a second trip to Grenada and one to Trinidad, always in pursuit of treeboas.

Despite my best efforts to keep Joel focused on snakes, his early fascination with iguanas would not go away. He counts seeing a male *Iguana iguana* sprawled on a branch high above a river in Belize among his fondest memories. Working with Chuck Knapp, his first sighting of *Cyclura* on Andros was another high point, along with seeing Billy, the Blue Iguana (*C. lewisi*) emerging from the brush to greet him for the first time on Grand Cayman. Despite being ultra-sensitive to poisonwood (Joel’s wife Cathy is a nurse, and, when she picked him up at the airport after his return from Andros, the first stop was the emergency room at the local hospital.), he has returned to the Bahamas to be of assistance as needed.

Joel has been, and continues to be, active in iguana conservation. He designed: the old and new logos for the International Iguana Foundation, signs for protection of *Iguana delicatissima* on St. Eustatius, a Hurricane Ivan t-shirt for Grand Cayman Iguana promotion, *Cyclura pinguis* art for the San Diego Zoo, the logo for the Turtle Survival Alliance, the Dr. Frederic Frye Veterinary Medicine Award, the Utila Iguana t-shirt, header art for the Anegada Wildlife News, a t-shirt for conservation of iguanas on Saba, a “Save the Andros Iguana” poster for Chuck Knapp that he distributes on Andros, and cartoons for the Blue Iguana Recovery Program. One of Joel’s most recent artistic endeavors is the design for the King Blue Bobblehead figure, the head of which is based on his meticulously detailed Blue Iguana bust. He also helped build head-start cages for *Cyclura* on Anegada.

For his own enjoyment, Joel has created wonderfully detailed sculptures of various species of iguanas (as well as the occasional monitor, tortoise, and snake). These are scale-for-scale representations and each is hand-painted. The elegant sculptures can be viewed at www.scaledArt.com. I’m the proud owner of two.

Attached to their home in San Rafael is the RWH Cyclurium, a walk-in habitat for a male *Cyclura cornuta* and a male *C. lewisi x C. caymanensis* hybrid (the two guys are separated by a wooden door). Joel and his 4-year-old son Mason check on the iguanas every morning; with Joel’s enthusiasm for iguanas, I’m sure it’s just a matter of time before baby daughter Avery makes it a threesome.

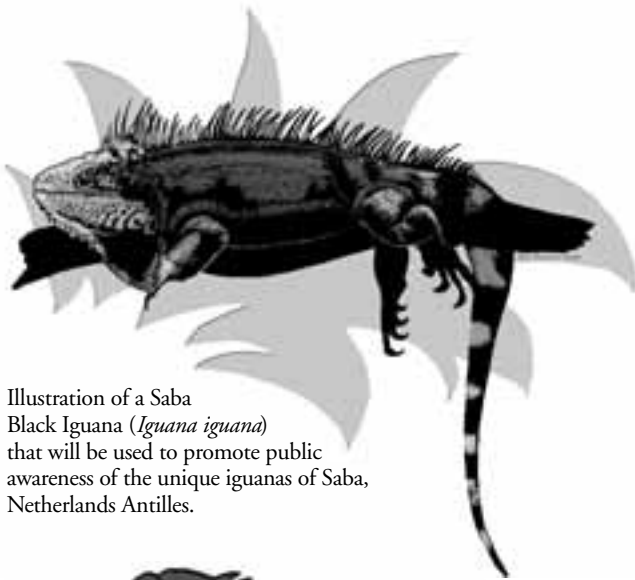


Illustration of a Saba Black Iguana (*Iguana iguana*) that will be used to promote public awareness of the unique iguanas of Saba, Netherlands Antilles.



Illustration of a Stout Iguana, *Cyclura pinguis*.



Illustration of a Rhinoceros Iguana, *Cyclura cornuta*.



An illustration of an Utila Iguana (*Ctenosaura bakeri*) that Joel created to support the Conservation Program for the Utila Iguana.



MARINA BEHRNDT, TEACHER

At an IRCF-sponsored educational event at Marin Formative, San Rafael, in April 2005, Joel displays “Duke,” his Grand Cayman Blue and Cuban Iguana hybrid (*Cyclura lewisi* x *nubila*) to young attendees.



JOEL FRIESCH

Cyclura lewisi population survey in June 2002 (from left: Joe Wasilewski, Alberto Jaramillo, Fred Burton, and Joel Friesch).



JOHN BINNS

Joel arriving in Tortola, BVI in 2001 waiting to clear immigration on the way to Anegada.

TRAVELOGUE

Mayan Reptiles

Michael A. Powell

Truman State University, Kirksville, Missouri

All photographs by Michael or Robert Powell.

We had nearly made it to the top of the massive pyramid at Ek Balam (how the Mayans climbed these suckers is a mystery to me; they were short little guys and the steps were tall and steep). I happened to glance over to a small shelf adjacent to the reconstructed steps, only to see an iguana staring back at me. Iguanas (*Ctenosaura similis*) are common on and around the ruins, which provide ample retreats and basking sites while offering protection officially afforded the ruins, but obviously extending to their reptilian residents as well.

Having traveled with my father my entire life, I have learned to expect that some portion of any given trip will involve time spent with the local fauna. I therefore had no illusions going into our holiday trip to the Yucatán Peninsula. Truth be told, I didn't really mind. It would have been hard growing up with someone like my dad and not developing an appreciation for that sort of thing.

We encountered animals with some degree of regularity, although the weather wasn't necessarily ideal, particularly for herps — or the locals, who complained bitterly about the cold. We, in stark contrast, were glad to be wearing shorts and t-shirts, while news of snow and ice storms back home dominated the weather channel.

Our first animal encounter was a Collared Toucan (*Pteroglossus torquatus*) that welcomed us to México as we emerged from the airport. Unfortunately, this was the only toucan sighting of the trip. The next day, however, we found something more up our alley. While wandering around the Mayan ruins at Chichen Itzá and Ek Balam, we found the iguanas that

had taken up residence there. On one of the smaller structures at Chichen Itzá, we counted sixteen lizards while standing on one spot. Although the cool conditions were not what one could call prime iguana weather, we found more than enough to make a destination selected for its historical interest more than a little interesting from a biological perspective. In addition to encounters at the ruins, we regularly saw iguanas on the grounds of our resort, where several had taken up residence in rock piles at one



A juvenile *Ameiva undulata* takes advantage of refuges provided by the crumbling ruins and of the protection afforded this screened stand supporting an ancient Mayan tablet.



Near the top of the pyramid at Ek Balam, I glanced to the side and saw an iguana staring back.



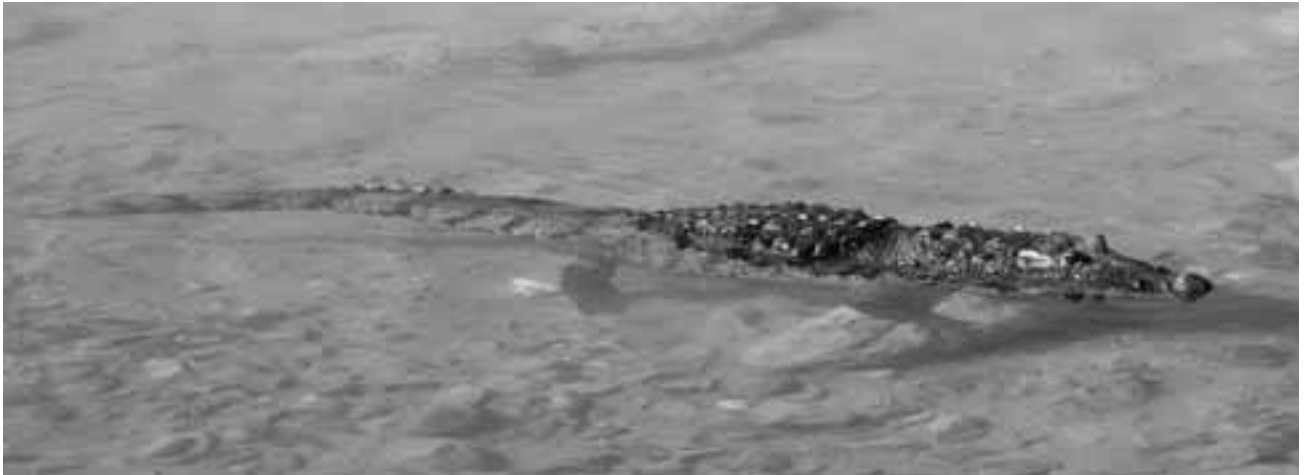
Ctenosaurs (Ctenosaura similis) are abundant on the Mayan ruins at Chichen Itzá.

end of a large pond with signs that warned us not to feed the crocodiles. Unfortunately, we never did see the crocs there.

We did, however, see crocs near the archaeological site at Cobá. My dad was attempting to photograph a Motmot (a bird with a pair of bizarre tail feathers that appear to be missing portions of their vanes) when a gardener warned him about the crocs in the lake. Of course, a warning for ordinary folks is a call to action for us. We quickly crawled through the carefully trimmed hedges near the shoreline and immediately came upon a 12-foot-long croc lazily basking in the shallows. Morelet's Crocodiles (*Crocodylus moreletii*) are an endangered species that once ranged widely through Middle America. Years of exploitation have left only a few occupying isolated enclaves such as the lakes at Cobá. Here the crocs are relatively common and often congregate near shore, where locals sometimes feed them scraps to entertain the tourists. The individuals we encountered were either well-fed or we didn't look or smell too tasty, since they were content to bask as we photographed them to our heart's content from only a couple of meters away.



A Turquoise-browed Motmot (*Eumomota superciliosa*) near the lakes at the Cobá archaeological site.



These Morelet's Crocodiles (*Crocodylus moreletii*) in the lake at Cobá were not at all disturbed by our presence.

Perhaps the most interesting encounters involved the highway. When traveling, we always stop from time to time to examine roadkills. Generally, that's what we find — roadkill. Twice on this trip, however, we encountered something much more interesting. We were driving the back roads from Chichen Itzá to Ek Balam when we saw a fairly large snake in the middle of the road. Dad immediately said: "Boa!" and hit the brakes. After a quick U-turn, we were once again approaching the snake and my dad was turning to pull off to the side of the road. As he leaned out the window to see if the snake was alive or not, he failed to see an oncoming car — at least not until my mom brought him back to reality. Fortunately, dad continued off the road and the other driver adroitly avoided hitting us. Dad immediately jumped out of the car and picked up the snake —



Rescuing a boa (*Boa constrictor*) from the highway nearly resulted in a collision with oncoming traffic.



The Barba Amarilla (*Bothrops asper*) is a common and deadly snake.

a fairly good-sized *Boa constrictor*. The driver of the other car also pulled over and got out. To Dad's dismay, he was wearing the uniform of the local policia. Dad immediately apologized in his broken Spanish (I caught the words "estoy idiota"). Fortunately for us, the policeman seemed a bit taken aback by a gringo who picks snakes up off the road. He stopped well short of us, asked if the snake was alive. As dad responded in the affirmative, the cop smiled nervously, shrugged, got back in his car, and drove away. We took several photos, which didn't seem to please the snake at all — I kind of felt like I was playing paparazzi to the boa's Sean Penn as it struck repeatedly at me and the camera.

Later the same day, after touring the archaeological zone of Ek Balam, we saw another snake crawling across the road. This time we stopped without incident. Dad immediately recognized it as a Barba Amarilla (*Bothrops asper*), one of the more common snakes in the region and also one of the most dangerous. Having already experienced the hostility of local reptiles toward photographers, I opted not to get involved with this one; instead I merely watched from the car as dad rescued the snake, photographed it, and then encouraged it to crawl off into the brush alongside the road.

As our trips to the tropics go, we spent relatively little time in the Yucatán hunting critters. That said, the time we did spend was exciting enough (read: had enough near-death experiences) to keep me satisfied.

A Yucatecan Adventure

It's hard not to feel some sense of adventure when you're standing on top of a pyramid built by a long dead civilization, looking out over a thick, green jungle — even though the person standing next to you appears to have been getting his senior citizen discount for a good 15 years, ropes and guard rails everywhere try to keep the less coordinated from plummeting to their deaths, and souvenir shops are visible back where you parked. Nevertheless, I felt as though I should have donned my fedora and grabbed my trusty bullwhip before setting out on such an expedition — but I'm getting somewhat ahead of myself.

The day after arriving in México, we visited Chichen Itzá, one of the best known of the Mayan ruins that dot the Yucatán Peninsula and adjacent regions of Central America. I knew something about the ruins already; my dad had been here 25 years ago, and had given me a bit of a briefing. We paid for our tickets and entered the park. A short walk from the entrance, we emerged from the forest into a clearing dominated by a towering pyramid, every architectural feature of which seemingly represented some aspect of Mayan astronomy. We set out to climb the massive structure. We had arrived early in order to avoid the



Climbing the large pyramid at Chichen Itzá is a daunting task.

tour-bus crowds and we wanted to get up and down the pyramid without being trampled by masses of German tourists going on their industrious way. We arrived at the top, looked around the painfully empty inner chamber, and enjoyed the view of the rest of the site. By this time, more tourists had begun to arrive, and we started back down. Climbing up the pyramid was tough, simply because of the many really steep stairs. Climbing back down was even more exciting, as the uneven steps and downward perspectives emphasized the possibility of one small misstep leading to a rather unpleasant ride ending with an even more unpleasant landing.

According to the guidebook, the pyramid had been built over an earlier, smaller structure, which was accessible. This sounded like an adventure, braving booby traps and ghosts of Mayan guards to enjoy the splendor of an ancient temple. Humming to myself, I followed a line of people into the pyramid. The path was dark, but not too difficult. It quickly turned into a huge set of stairs. I started climbing, figuring that the temple at the top and its Red Jaguar Throne would be an ample reward for my effort. I finally reached the top, only to find that the “temple” consisted of a poorly lit room and that the “throne” was more like a bench that I couldn’t see very well. The whole area was smaller than my dorm room — and anyone who’s lived in a dorm can appreciate just how tiny that is. Disappointed, I made the trek back down. So much for Indiana Powell.

My mood improved, however, as we wandered through the rest of the ruins, learning about ancient Mayan culture. The ball court, where the intent was to pass a ball horizontally through a stone ring hung high on a wall, was interesting, both in terms of the fates of the losers (rather grim) and for the fact that the walls were so precisely designed that a clap in the middle of the field would echo exactly seven times.

We next followed a *sacbe* (an old Mayan “road”) that extended from the clearing past a retaining wall that surrounded the center of the city, which had been built on an artificially raised, level platform. As impressive as the construction of the pyramid and temples had been, I was amazed that such a “primitive” culture could accomplish the immense task of moving thousands of tons of soil and compacting it adequately to support the huge stone structures. The road led on past the wall to a cenote, essentially a natural cistern that served as both a cere-

monial site and a water source for the city’s inhabitants. It was what it was — a massive hole in the ground with water in it. Being who we are, our attention was immediately attracted to a bird perching on a small tree near the bottom. It turned out to be an Anhinga or “snake-bird” (so called because of its “serpentine neck”).

I must admit that I was somewhat disappointed at how developed the site had become. I had been looking forward to climbing the various structures, an activity that’s discouraged — it’s hard on the ruins, particularly with the vast numbers of people that visit the site. Ultimately, though, I had to admit that it was better this way. The sacrifice of my adventurous fantasies was worth the price of preserving the ruins, and the development of the site into a tourist attraction was more than justified by the worthy goal of exposing the average cruise ship passenger to a little ancient culture.



The retaining wall around the elevated platform on which the main structures at Chichen Itzá were constructed clearly demonstrates the engineering feats of which the Mayans were capable.



Returning from the cenote along the ancient *sacbe* (road), the pyramid at Chichen Itzá is an imposing structure.

MAYAN SITES

Although Mayan archaeological sites extend across the Yucatán Peninsula and throughout much of Central America, visitors to the region who land in Cancún should definitely include the following four sites in their travel agendas. Visits early and late in the day are strongly recommended; not only are temperatures more pleasant, lighting more varied, but the vast busloads of tourists, especially at Chichen Itzá and Tulum are thus avoided to a large degree. Adapted from material provided at <http://www.mayasites.com/>.



Map of the Yucatán Peninsula showing the approximate locations of Cancún and the four major Mayan archaeological zones in the northeastern part of the peninsula.

Chichen Itzá

Maybe the most famous of all Mayan archaeological sites, Chichen Itzá dates from the Late Classic period (~600–900 AD). Within the 6 km² of the archaeological zone are two distinct architectural styles (classified as “new” and “old” Chichen). The glorification of the Toltec god Quetzalcoatl in his Mayan form of Kukulcan, the Feathered Serpent, led to the belief that the Toltecs had taken over this formerly Mayan city. Now, however, scholars are beginning to dispute the idea of a foreign invasion. Contemporary thought is that Chichen Itzá was a cosmopolitan city inhabited by a diverse group of peoples including the Puuc Mayans and the Toltecs.

Ek Balam

Dating from 100 AD to its height at 700–1,200 AD, the newly opened archaeological site at Ek Balam is unique and well worth a visit before the word gets out and the site is overrun by tourists. The main temple is over 500 feet long and 200 feet wide, making it one of the largest structures ever excavated in the Yucatán. Various sculpted works are

extremely well preserved. The site’s most striking temple is the “monster mouth,” representing a portal to the “other world.”



Tulum was the only Mayan city still thriving when the Spanish conquistadors arrived.



Many sculpted works at Ek Balam are extremely well preserved.

Tulum

Situated on a cliff facing the beautiful turquoise waters of the Caribbean, this is among the most scenic of all the Mayan sites. Tulum was at its peak from 1,000–1,600 AD and is unusual in being surrounded by a high wall that speaks to a need for defense against invaders from both land and sea. Tulum was one of the first cities encountered by the conquistadors and was the only Mayan city still thriving when the Europeans arrived. The Mayans eventually abandoned the city, but not until almost a century after the Spanish conquest.

Cobá

The Mayan ruins at Cobá are unique in that they have been barely restored. Only a few of the estimated 6,500 structures have been uncovered. Cobá, dating from



Tulum is situated on a cliff overlooking the Caribbean and is among the most scenic of all the Mayan sites. Waves breaking over the barrier reef that parallels the coastline can be seen in the background.



Climbing the pyramid at Cobá was exciting, as the uneven steps forced one to consider how one small misstep would lead to an unpleasant and possibly lethal experience.



The main pyramid at Cobá is the highest Mayan structure on the Yucatán Peninsula.

600–900 AD, may once have had a population estimated at 100,000 people, largest of all the ancient Mayan cities. The site's pyramids and buildings are situated on the shores of several lakes and as many as fifty *sabes* (ancient roads), one of them over 62 miles long (longest in the Mayan world), connected Cobá to cities throughout the region. The Nohoc Mul pyramid, at over 126 feet, is the tallest Mayan structure on the Yucatán Peninsula, and the building techniques are characteristic of the Petan region of Guatemala.

25 Years of Change

Several years ago, before a visit to México after an absence of over ten years, a friend who traveled south of the border on a regular basis told me that I would immediately notice three major changes that had come to pass since my last trip: (1) There are a lot more Mexicans (villages had become towns, towns cities, and cities major metropolitan areas). (2) One can buy safe ice nearly everywhere (in the old days, one often had to search diligently for the local ice plant and then, not knowing the source of the water used, had to be extremely careful for fear of contracting what is widely known as “Montezuma’s revenge”). (3) The PEMEX (Mexican national petroleum company) stations had clean restrooms (during previous visits, even females invariably preferred the “bushes” to the often-gruesome facilities at the filling stations). All of his observations were right on the money.

If such dramatic changes were evident after only ten years, you might imagine what had happened in the 25 years since I had last visited the Yucatán Peninsula with students in 1980. I won’t try to list them all, but some of the innovations were impossible to ignore — and some were a bit disturbing.



One significant advantage of development is access to fine dining establishments.



This juvenile *Coleonyx elegans*, a eublepharid gecko, was crossing the road at night. Travel speeds that prevail today would have made seeing this little lizard difficult and stopping in time to catch it nearly impossible.

Mexicans are definitely more abundant. Cancún has grown from a little town into a booming metropolis with all of the accompanying traffic and pollution. Playa del Carmen is a city (with a Sam’s Club!) instead of a sleepy seaside village. Much of the population growth is attributable to immigration into the region from other parts of México. When the government decided to foster development for the tourist trade some 40 years ago, it began the process by constructing an international airport. When we visited in 1980, the airport had been in operation only a few years and the terminal was an open-air affair through which one passed in seconds. Today, the airport rivals those in large cities anywhere in the world with jet ways, huge customs complex, and stores and restaurants galore (even a Hard Rock Café). In 1980, our rental vehicles had to be brought in from Mérida (capital of the state of Yucatán); today the rental car options equal those at any major international destination. Growth and expansion continue.

The more popular archaeological sites at Chichen Itzá and Tulum now have paved parking lots with attendants, extensive visitor centers, and the free-lance vendors of largely hand-made crafts have been replaced by row after row of shops catering to almost any whim (local vendors still exist, but their access to the sites is carefully controlled). Getting there is faster, since the old two-lane roads that had only recently been paved were now four-lane, limited-access highways. Deserted stretches of beach have been replaced by one huge resort after another, and, instead of nesting sea turtles, the beaches are occupied by dense crowds of tourists covered in oil. Note, however, that many of the attractions that promote near-shore snorkeling experiences require (and sell) biodegradable sunscreen to prevent the formation of huge oil slicks.

Sadly, the remaining Mayan culture that we experienced so vividly in 1980 is much less visible today. This is partly attributable to the speed of travel (one couldn’t drive fast on the old roads even if so inclined) and partly to the displacement of



Mayan villages along the roads have been displaced by commercial development along the highways.



Treefrogs, like this *Phrynobates venulosa*, are abundant, but inconspicuous — until the males call during rainy periods.



Archaeological zones provide protection for wildlife as well as ruins. Here a Great Egret (*Casmerodius albus*) waits patiently for lunch at the lake at Cobá.



Red-eared Sliders (*Trachemys scripta*) are not native to the Yucatán Peninsula, but the crocs seem to find them every bit as tasty as the native species.

Mayan villages farther into the interior to make room for profitable enterprises. Mayan faces were common then; today, one encounters them only rarely, usually in the form of maids or laborers with whom tourists have limited contact.

Wildlife still exists, but the diversity that was so evident 25 years ago is much harder to find (during our 1980 trip, we collected 25 snakes of 17 different species). Those species that adapt well to humans and their altered habitats abound; those that don't have retreated farther into the remaining forests, access to

which is now more difficult. We were able to enter the forests along numerous small dirt roads that led to little villages or hunting and logging camps. These no longer exist. The huge flocks of shore birds that populated the myriad inlets and bays have moved to the protected biosphere reserves farther south and are rarely seen along the Mayan Riviera, replaced instead by motorboats and jet skis (an abomination and a sure sign of a declining civilization).

Was the Cancún of 1980 more charming than what exists now? Sure. However, I have a hard time condemning the development. Not only has it proven to be an economic boon in a previously depressed area (well over 90% of all local revenue in the state of Quintana Roo is tourist-related), a large portion of the millions of tourists who have visited the region in the past couple of decades have been enticed to visit the archaeological sites — and a few may well have left with a much greater appreciation of pre-Columbian culture than they could have acquired by watching the travel channel. Knowing our past speaks well of our future, and tourism, albeit motivated largely by white-sand beaches and crystal-clear water, has been largely responsible for the education of many.

Robert Powell

MUCH MORE THAN AN ALLIGATOR FARM

Just north of Puerto Morelos on what has become known as the Mayan Riviera, is a small roadside zoo called CrocoCun. As the name implies, crocs are the featured attraction — and both American Crocodiles (*Crocodylus acutus*) and Morelet's Crocodiles (*C. moreleti*) are abundantly represented. In fact, the privately supported facility has become sufficiently adept at breeding the latter that they have run out of sites to release them (many of the developers of luxurious resorts along the Caribbean coast apparently resist efforts to reintroduce crocs to the lagoons and beaches where they once were plentiful).

However, this little zoo offers much more than crocodiles. Exhibits include many species native to the forests of the Peninsula, including several snakes, a few lizards, and mammals that include Whiterail Deer (*Odocoileus virginianus*, yes, the same species overrunning suburbs throughout the United States), Collared Peccaries or Javelinas (*Tayassu tajacu*), and Spider Monkeys (*Ateles geoffroyi*).

Because the rather steep admission price includes the services of a guide, visitors can interact with animals, feeding monkeys or deer and holding snakes or even crocs. Even more interesting, however, than some of the exhibits are the wild animals that have learned that the zoo is an ideal place to scrounge an easy

meal. Wild Spider Monkeys readily approach humans in hopes of a handout and the fortunate visitor might stumble across an iguana foraging for scraps or a snake taking advantage of the rodents attracted to the stocks of animal food kept onsite.



Wild Spider Monkeys (*Ateles geoffroyi*) had learned that the zoo was a good place to solicit a handout.



Crocs start out small, but don't stay that way. The author holding a hatchling *Crocodylus moreleti* (left). An adult *C. moreleti* at the breeding facility at CrocoCun (above).



With their bright blue backs, wings, and tails, Yucatan Jays (*Cissilopha yucatanica*) provided atmosphere in the form of raucous calls and splashes of color.

Nearby and also worthwhile is the Dr. Alfredo Barrera Marín Botanical Garden, with winding paths snaking through the various vegetative communities found on the Peninsula. In addition to the flora, the facility also is a terrific place to see birds, occasional reptiles, and sometimes even a fleeting glance of a wild mammal disappearing into the brush.

Also worth exploring, at least for the aquatically inclined, are the fabulous coral reefs that parallel the coast, forming North



The very slender Vine Snake (*Oxybelis aeneus*) feeds primarily on lizards. These snakes were abundant 25 years ago and remain that way today.

America's longest barrier reef. Unfortunately for tourists (but presumably fortunate for the area's inhabitants), core areas of the region's terrestrial and coastal Biosphere Reserves are off-limits to casual visitors. Biologists, archaeologists, and other scientists must obtain permission from the Mexican government to conduct research in these areas.

Numerous other "natural wonders" are promoted on billboards along every stretch of highway, in every brochure that offers daily tours, and by the staff of "activity desks" at the area's abundant hotels and resorts. Most are pricey and some may be worth the investment of time and money, but don't go expecting to see anything remotely resembling nature. What were once pristine and unique habitats supporting an unbelievably diverse wildlife have become just another tourist attraction.

SOME ADVICE

Use sunscreen. Even during the cooler winter months, the tropical sun is fierce and will fry you much faster than anything you've experienced back home.

Take insect repellent. Although I overheard one tour guide tell visitors to Cobá not to worry about bugs, reminding them that it was winter and "mosquitoes don't like snow," the truth is that biting insects are abundant — and seem to enjoy the taste of tourists.

Don't be paranoid about food and drinks. The bad old days are in the past. The tourist-oriented economy on the Peninsula has adapted well to the reality that folks won't come back if they spend most of their vacation worshipping at the porcelain alter. Do, however, use common sense. Avoid food purchased from street vendors and eat fresh fruits only if served in a reputable restaurant or that you've peeled yourself. Tequila is not a disinfectant that will save you from your sins if you eat something you should have avoided.

As much as possible, plan activities for early and late in the day. Midday temperatures can be brutal and no one has fun in a blast furnace. Also, most animals are likely to be active in the morning and evening. So, eat a light lunch and take a siesta (a very civilized custom) or spend time in the pool or at the beach (but not in the sun!).

If you decide to drive, figure on paying a premium for local insurance (U.S. insurance does not apply in México). When you drive, be patient. Even if the locals drive like they're in a NASCAR race (go fast, turn left, ...), don't emulate them. Traffic violations involving injuries or property damage are criminal offenses and even minor transgressions can be expensive, since you may end up paying the arresting authority a substantial amount to allow you to proceed on your way (incidentally, don't automatically assume that a policeman is looking for a bribe, that could get you into even more trouble, but follow Boy Scout guidelines and be prepared).

Above all, enjoy yourself. México is a terrific place full of mostly friendly people and with lots to offer in the way of cultural and natural history.

References

General Guides

Numerous guidebooks address the logistics of travel to what has become one of the Western Hemisphere's major tourist destinations. All provide some basic background on the archaeological sites buried among recommendations for lodging, dining, and experiencing the apparently abundant nightlife. All are totally devoid of any meaningful discussions of the region's natural resources (except those that have themselves been converted to tourist destinations). Two guides that we found particularly useful, primarily because they went farther beyond the mundane than most of the alternatives, were: *Yucatán* (Lonely Planet) by Ben Greensfelder and *Hidden Cancún & the Yucatán* by Richard Harris.

Reptiles and Amphibians

The Amphibians and Reptiles of the Yucatan Peninsula by Julian C. Lee. Phenomenally comprehensive, a reference rather than a guide. Highly recommended, but expensive and not for carrying into the field.

A Field Guide to the Amphibians and Reptiles of the Maya World: The Lowlands of Mexico, Northern Guatemala, and Belize by Julian C. Lee. A field guide based on the more authoritative coffee table book by the same author. Highly recommended.

Amphibians and Reptiles of Northern Guatemala, the Yucatán, and Belize by Jonathan A. Campbell. A nice guide enlivened by tales of the author's per-

sonal experiences in the region. Recommended.

Reptiles of Central America by Gunther Köhler. Nicely illustrated, but broader coverage than the other books listed results in less detail than in the other recommended guides. Recommended, but expensive.

Birds

A Guide to the Birds of Mexico and Northern Central America by Steven N. G. Howell and Sophie Webb. The most comprehensive guide to the region, but large and heavy. Highly recommended.

Birder's Mexico (Louise Lindsey Merrick Natural Environment Series, 12) by Roland H. Wauer. Not so much a traditional guide as an introduction to birding in México; definitely nice to have and great for preparation prior to a trip. Recommended.

A Field Guide to Mexican Birds: Mexico, Guatemala, Belize, El Salvador (Peterson Field Guides) by Roger Tory Peterson (Series Editor) and Edward L. Chalif. Not up to the standards of the Peterson Field Guides for the U.S. and useful only with both U.S. guides in hand. Definitely a third choice among those listed.

Field Guide to the Birds of Mexico and Adjacent Areas: Belize, Guatemala, and El Salvador by Ernest Preston Edwards and Edward Murrell Butler (illustrator). Nice pictures, but disorganized and difficult to use. Not recommended.

SPECIES PROFILE

Blunt-headed Tree Snake *Imantodes cenchoa*

Snakes in the genus *Imantodes* are among several Central American species to effectively exploit arboreal prey. Like many other species that spend most of their lives in vegetation, these snakes are very slender and elongate and have very long tails. Compressing their sides and forming their bodies into a semblance of an I-beam, they can span remarkable distances as they move from branch to branch. Although they can and do occasionally venture onto the ground, most individuals probably never leave the trees and bushes on which they're usually encountered. Active at dusk and well into the night, these snakes take refuge during the day, occasionally hiding in bromeliads or other epiphytic vegetation.

As do many Neotropical snakes in the Family Colubridae (which includes most common snakes throughout the world), Blunt-headed Tree Snakes have enlarged, grooved teeth near the back of each upper jaw with which they can inject venom. However, the location of the fangs renders the delivery of venom difficult unless the prey item has been taken well into the mouth. Also, the venom appears to be most effective on their usual prey of lizards and frogs. They are not dangerous to humans and very rarely bite, even when handled.

Unlike Vine Snakes in the genus *Oxybelis*, which fill a comparable arboreal, lizard- and frog-eating niche during the daytime, *Imantodes cenchoa* has a vertically elliptical pupil that allows for considerable enlargement in order to trap sparse light at night. Like most snakes, however, Blunt-headed Tree Snakes rely primarily on chemical cues to find lizards sleeping on branches and leaves, nocturnally active frogs, clutches of frog eggs suspended over water, or lizard and snake eggs hidden under bark or in nooks and crannies above the ground. Their blunt heads allow them to consume larger prey than their slender bodies would seem to be able to accommodate.



The long slender bodies of Blunt-headed Tree Snakes (*Imantodes cenchoa*) allow them to span considerable distance as they move from branch to branch.

HISTORICAL PERSPECTIVES

Camps in the Caribbees: The Adventures of a Naturalist in the Lesser Antilles¹

Frederick A. Ober

Dominica

Late in the afternoon ... we descried a speck dancing on the waves, which speck was, of course, a boat; and in that boat, when it reached us, I engaged passage for the shore, my unhappy companions drifting about until the next afternoon, sometimes in sight, sometimes lost of view for a long time. As we neared shore I had time to examine the character of the scenery of the western coast, as one object after another was unfolded, and the mass of green and blue resolved itself into wooded hills, narrow valleys, and misty mountain-tops that reached the clouds. A planter's house gleamed white in a valley; a pebbly beach stretched between high bluffs, with a grove of cocoa palms half hiding a village of rude cabins along its border.

I was approaching an island of historic interest and scenic beauty, of which the events of one and the elements of the other are little known to the world at large. It is the first island upon which Columbus landed on his second voyage. Having been first seen on Sunday, it was called by him *Domínica*, and this event dates from the 3d of November, 1493. Blest isle of the Sabbath day! Many changes has it known since the great navigator first saw its blue mountains and landed upon its fragrant strand.

Does it read like a fairy tale, this second voyage of Columbus? With three ships and fourteen caravels, containing fifteen hundred persons, he set sail from Cadiz, touched at the Canary Isles, and then shaped his course for the islands of the Caribs, of whose prowess and fierce nature he had heard many stories from the mild people of Hispaniola. At the dawn of day, November 3d, a lofty island was descried to the west. As the

ships moved gently onward, other islands rose to sight, one after another, covered with forests and enlivened by flights of parrots and other tropical birds, while the whole air was sweetened by the fragrance of the breezes which passed over them.

Grenada and the Grenadines

Skirting the belt of mangroves bordering the lagoon, one morning in March, I anxiously searched the intertwined branches for iguanas. Grenada is celebrated as being the home of great numbers of these reptiles, which may often be found basking on old walls within the limits of the town. My boatman was a negro, who, accustomed to the appearance of the iguana in the trees, discovered one long before I could distinguish the difference between the reptile and green leaves. Even after it had been pointed out, I had difficulty in recognizing it, so nearly did its colors harmonize with those of the tree in which it was feeding.

It lay quite still, stretched flat upon a branch, its tail hanging down like that of a snake. Though it was evidently suspicious of our intentions, its quiet was not due to that alone, for it is normally a sluggish animal. Yet, when once thoroughly aroused, it will dash over the ground at great speed. I fired, yet it still clung tenaciously to the bough, and a second shot did not kill it, for it would have escaped had not my boatman pinned it with an oar, after it had fallen into the mud. From one that we captured that morning, the man with me procured a dozen large, white eggs, which he saved to eat...

The order *Sauria*, the lizard order, is well represented in the West Indies, though in none of the smaller islands between Porto Rico and Trinidad is to be found that greatest of the saurians, the alligator. The Indians of Dominica, to whom I described the alligator, were greatly amazed to hear of a 'lizard' twelve feet in length, as they had never seen one larger than an iguana, which seldom attains a greater length than five feet, and is as mild in disposition as the alligator is sanguinary. The islands, especially the shores, are teeming with lizards of every color, of every variety of marking, and of all sizes.

Especially do they love the cliffs, and if you are walking through the bushes at the base of any sunny precipice, or over any rocky tract, you will be startled by the frequent dashes made by these reptiles across your path. In a country where you must keep every sense on the alert, to guard against sudden surprise by serpents or poisonous insects, it is very annoying, often startling, to be so frequently disturbed by these active creatures. In the mountains are fewer species, and they are more sluggish, but



CLENN GEMBER

A Saban iguana (*Iguana iguana*), "I had difficulty in recognizing it, so nearly did its colors harmonize with those of the tree in which it was feeding."

¹ Excerpted from the book with this title published initially in 1879.



HANS E. A. BOOS

Fer-de-lance (*Bothrops lanceolatus*), “The dread of the serpent is universal. It seems to possess a hatred for man; and it is seriously avowed by the natives that it will lie in wait for an opportunity to inflict death.”

in the warm lowlands you must be very active to capture one.... They are not poisonous, though repulsive to many, and though some of them will bite severely, they do not inflict dangerous wounds.

There are many hideous forms, especially among those of South America, like the Basilisk and the Flying Dragon; but in the West Indies there is none more hideous than the iguana. Never was more harmless creature invested with more frightening aspect.... In the islands where it exists it is eagerly sought as food, and its flesh is palatable and delicate, as I can testify from experience, being white, tender, and nutritious.

The good father Père Labat (worthy missionary and *bon vivant* withal) compares fricasseed guana to chicken for the whiteness of its flesh and delicacy of its flavor....

Some Summer Days in Martinique

Centipedes and scorpions also abound here. Indeed, it seems that nature has bestowed upon this island of Martinique all the pests and scourges known to these islands; for only here and in the adjacent island of St. Lucia is found that most venomous and vengeful of all serpents, the Lance-head snake *Craspedocephalus lanceolatus* [= *Bothrops lanceolatus*]. The isolation of this snake on these two islands, when its nearest habitat is Guiana, is one of the most vexing stumbling-blocks to one studying the distribution of animals. How came it here? Was it introduced, or is it indigenous? Was it wafted here upon some

floating tree, or was its home here from the beginning? The correct solution of this problem would, doubtless, throw some light upon that more important and gigantic one, Were these islands once a part of the continents? Certain it is, the adjacent islands of Dominica and St. Vincent, separated from these channels less than thirty miles in width, are free from this scourge. Nay, more; it is recorded that, during the wars between the English and the Caribs, in the last century, the Lance-head was carried to the islands just named, but could not be made to live.

Annually, during the crop season, many laborers are killed in each island, for this snake has its hiding-places in the canes as well as the forests. It has been so abundant that in this garden the pleasant walks and shady drives are nearly always deserted. A serpent over seven feet in length, killed in the garden, is shown in the Museum. There is, it is said, no antidote for its bite.... The poison is quickly fatal, and decomposition rapidly follows.... The dread of the serpent is universal. It seems to possess a hatred for man; and it is seriously avowed by the natives that it will lie in wait for an opportunity to inflict death. The country people live in continual trepidation, and very few of them will venture from their houses after dark, even in the suburbs of the city.



St. Pierre, Martinique in 1888, 14 years before the eruption of Mt. Pelee, “Indeed, it seems that nature has bestowed upon this island of Martinique all the pests and scourges known to these islands; for only here and in the adjacent island of St. Lucia is found that most venomous and vengeful of all serpents, the Lance-head snake...” (Lanceheads from Martinique, St. Lucia, and mainland South and Central America are now considered separate species). Photograph courtesy of Philip Walwyn



ROBERT POWELL

“The islands, especially the shores, are teeming with lizards of every color, of every variety of marking, and of all sizes.” *Anolis aeneus* from Union Island (The Grenadines) (left) and *A. richardii* from Grenada.

Florida and the West Indies¹

Prof. F. A. Ober

Hitherto we have been in pursuit of information pure and simple; I now claim the privilege of a relaxation, and ask you to paddle off with me to the hunter's fairyland, to the elysium of reminiscences.

Let us go camping out. You know how it is in camping out; a man divests himself of every artificial surrounding that makes life enjoyable and then sets out to enjoy it.

Indian River, a vast salt-water lagoon, is the paradise of the camper-out. The eddies of the Gulf Stream, in ages past, have thrown upon Florida's eastern shore such an accumulation of broken shells and coquina that the mouths of the Southern rivers have been closed, and their waters thrown back on the country, uniting laterally and forming extensive lagoons.

Indian River, 120 miles in length, connects with another system, the Mosquito Lagoon and Matanzas, giving altogether over 300 miles of protected water travel within the sound of the surf beat of the ocean.

All the game in Florida, bear, deer, turkeys, panthers, were once here in the greatest abundance. In the swamps along its borders were vast heronries, where, gathered by hundreds, were beautiful egrets and snowy herons with downy, filamentous plumes. Pelicans breed here by thousands, oysters are abundant, and on the sea-beach, in June, scarcely a night passes that we cannot turn over an immense turtle's nest containing half a hundred eggs. In this lagoon also is captured the bulky sea-cow, or manatee, sometimes 8 feet in length, and weighing 500 or 600 pounds.

Far down in the everglades, in the little-known interior of Florida, surrounded by impenetrable swamps and gloomy forest, lies the mysterious lake of the South, the vast Okeechobee.



JOE BURGESS

Roseate Spoonbills (*Ajaia ajaja*), like many other species of wading birds, were decimated by plume hunters around the turn of the 20th Century. They have recovered due to protective legislation, but have not reached the populations densities recorded by Ober and others during the late 19th Century.



JOE WASILEWSKI

American Alligators (*Alligator mississippiensis*) became endangered throughout Florida and much of the southeastern United States as a consequence of legal hunting and, more recently, poaching. Hides and meat were valuable commodities. Alligators have benefited from legal protection and their conservation status has been upgraded from endangered to threatened. The species is now abundant in many areas, although habitat loss and changes in water management continue to threaten them, as well as many other species in Florida.

At the commencement of the present century this lake was a little known as in the time of De Soto; and even 50 years ago, at the beginning of the Seminole war, every thing about it partook of the vagueness, and was tinged with the romance, that such an unexplored region, surrounded by Indians alleged to be hostile, was likely to create. Such it was even in 1874, when I organized my expedition to explore it. We were a month absent on this exploration, and my boat was the first to float upon its waters in nearly 30 years. We succeeded in dispelling the halo of exaggeration that surrounded the lake, and gave to the world a truthful account of its resources.

No creek or river formed the outlet of this vast body of water; the accumulated drainage of thousands of square miles of territory slowly percolated through the everglades by countless channels. Since my visit to Okeechobee, a company of capitalists has effected its partial drainage and added a vast area of cultivable land to Florida's territory. The only sections not in swamp or under water were covered with huge "India-rubber" trees, delicately foliaged box, and sweet-scented bay, their trunks covered with gorgeous epiphytes with flaming blossoms, and their branches, draped in Spanish moss, the roosting-place of vultures and turkey-buzzards.

In the southern portion of the peninsula—around Lake Okeechobee and near the northern keys—reside the few

¹ Excerpted from the 1886 *Journal of the American Geographical Society*, volume 18.

Seminoles left in Florida by the treaty of 1842—between two and three hundred only in number; and here they lead a peaceful life, cultivating their fields, and hunting.

It was while among the Seminoles, in 1872 and 1874, that I enjoyed my best sport hunting the alligator. All are, of course, sufficiently familiar with this saurian not to need a further description from me. By thousands and thousands the guileless alligator of tender years has been ruthlessly torn from the maternal breast and sent adrift upon the frozen North; hence, the alligator in a menagerie is as familiar as the ubiquitous monkey.

Even to-day, after having been the sport of tourists for years, they may be shot on the St. John's; though the best hunting is to be found in secluded creeks and bayous.

Though the alligator attains sometimes a length of 12 or 14 feet, he is more commonly found at 8 or 10. His jaw is always one fourth his entire length, and one 12 feet long displays an open countenance a yard wide. The teeth work up well into ivory ornaments, and the skin, when properly tanned, makes the most

durable of leather. Some hunting boots I had made from a pair of nine-footers lasted me five years' wear and tear by flood and field. The alligator's vulnerable spots are the eye, ear and just abaft the fore-leg. The rifle is the best weapon, but I have shot several dozen with a shot-gun and some even with a small revolver.

The alligator is daintily-choice in his food, preferring a dog to the piney-woods hog, and a juicy, well-developed negro to either. The bull alligators have a tremendous roar, which shakes the forest when they indulge in a concert. I once found them so numerous, in the Indian country, that we gave over shooting and took to harpooning them; a certain hunt by moonlight lingers in memory yet through a dozen intervening years.

One hundred years ago, when that quaint old philosopher and botanist, Bartram, sailed up the St. John's in his Indian canoe, the river was without a settlement its entire length, and the worthy man was frightened nearly out of his wits by the enormous alligators, which bit pieces out of his boat and nearly succeeded in devouring him.

BIOGRAPHICAL SKETCH

Frederick Albion Ober (1849–1913)

Frederick Ober was born in Beverly, Massachusetts, to a relatively impoverished family and had little formal education. At 14, he learned the shoemaker's trade, the traditional winter occupation of local fishermen; at 18, he was working in a drug store; at 21, he was in business with his father. However, his passion was ornithology. As a teenager, he taught himself taxidermy, collected and classified nearly all the birds of New England, and attracted the attention of Alexander Agassiz, the distinguished biologist from Harvard.

In 1871, Ober abandoned business and went on a major expedition to Florida to explore Lake Okeechobee, writing a series of vivid journal articles. For the next twenty years, he was an almost constant traveler, principally in the Caribbean, but also in México, Spain, North Africa, and northern South America. Ober initially saw himself as a scientist; he sent much material back to the Smithsonian Institution, two species of birds carry his name, and the Smithsonian published the report of his first Caribbean expedition. However, after the commercial success of his travel book, *Camps in the Caribbees: The Adventures of a Naturalist in the Lesser Antilles* (1879), Ober broadened his horizons and, after some financial struggles, made a career for himself as a travel writer, journalist, public lecturer, novelist, and historian.

Ober wrote over forty books, including three classic travel books: *Camps in the Caribbees* (1879), the long and beautifully produced *Travels in Mexico and Life among the Mexicans* (1884), and the book that resulted from his appointment as collector of Caribbean and Columbus-

related material for the quatercentenary, *In the Wake of Columbus: Adventures of the Special Commissioner sent by the World's Columbian Exposition to the West Indies* (1893). In addition, two of many novels had a contemporary Caribbean setting: *Under the Cuban Flag, or the Cacique's Treasure* (1897) and *The Last of the Arawaks: A Story of Adventure on the Island of San Domingo* (1901).

In the last years of his life he worked as a real-estate dealer in Hackensack, New Jersey, where he died in 1913. Since his death, nobody has taken much interest in Frederick Ober or his writings, but, during the last decade of the nineteenth century, Ober probably knew as much about the Caribbean as anyone in the United States. He had traveled widely in the region, especially in the more remote parts rarely visited by other travelers, met with many of the statesmen and leading figures, and read widely about the area's history. Nobody knew the contemporary situation of the small indigenous populations as well, and few had a better knowledge of its history and the history of Spanish colonialism with which it was intertwined. In one sense, however, this made Ober an atypical figure. After 1898, when the stream of writing about the Spanish-speaking Caribbean became a torrent, his would seem like a minor voice, that of an amateur drowned by the instant expertise of economists, sociologists, and other analysts of the backward islands that had fallen into U.S. hands.

Adapted from the online literary encyclopedia (<http://www.litencyc.com/php/speople.php?rec=true&UID=3390>).

C O M M E N T A R Y

Consider the Turtles of the Field¹

Many evangelicals find themselves in an emerging theological habitat, where care of creation is central to mission.

Brian McLaren

Right now, I'm thigh-deep in muck. Clad in hip waders, I'm sloggling through a spring-fed bog in northern Maryland. I'm surrounded by tussock sedge, alder, jewelweed, skunk cabbage, and swamp rose. And I'm having a great time.

I've done this for a couple of days almost every spring for the last dozen years. I'm out here as a volunteer to do wildlife surveys. In particular, we're looking for the rarest turtle in North America, *Glyptemys mublenbergii*, the little four-inch Bog Turtle. In the 1970s, they were found in more than 400 sites in our little state. In the 1990s, we could only find them in about half those sites. The other sites had been ditched, drained, bulldozed, polluted, invaded by non-native plants, bisected by roads for turtle-smashing cars, depleted by collectors, or otherwise made uninhabitable for these little creatures.

When I meet professional wildlife biologists and other volunteers, they're surprised that an evangelical (or post-evangelical, or "younger evangelical," or whatever) pastor would be out here doing this sort of thing. They're not used to seeing mud-smearing pastors who aren't afraid to grope around in bog muck for turtles or who keep track of chorus frogs and Baltimore checkerspot and Indian paintbrush. I know what they're thinking: Christians, especially ones associated with the term "evangelical," are part of the problem, not part of the solution. They listen to James Dobson and Pat Robertson and James Kennedy, not Wendell Berry and Herman Daly; they focus on the family and the military, not the environment.

The surface causes of environmental carelessness among conservative Protestants are legion, including subcontracting the evangelical mind out to right-wing politicians and greedy business inter-

ests...putting the gospel of Jesus through the strainer of consumerist-capitalism and retaining only the thin broth that this modern-day Caesar lets pass through...a tendency to be against whatever "liberals" are for. Even more important, though, are the deeper theological roots of environmental disinterest — and the emerging theological values that many of us are embracing instead.

People who are sensitive to creation know that creation is in constant flux. Continents drift, climates change, magnetic poles flip-flop, and bogs like this one gradually give way to wet meadows and then various kinds of forests. There's a natural succession out here under the sun, and I think there's a kind of natural succession going on theologically for many Christians as well. Let me mention three of these elements.

First, increased concern for the poor and oppressed leads to increased concern for all of creation. The same forces that hurt widows and orphans, minorities and women, children and the elderly also hurt the songbirds and trout, the ferns and old growth forests: greed, impatience, selfishness, arrogance, hurry, anger, competition, irreverence — plus a spirituality that cares for souls but neglects bodies, that prepares for eternity in heaven but abandons history on earth.

When greed and consumerism are exposed, when arrogance and irreverence are unplugged, when hurry and selfishness are named and repented of, the world and all it contains (widows, orphans, trees, soil) are revalued (or re-deemed) and made sacred again. No, in this emerging view, these little Bog Turtles we're looking for today are a priceless treasure, an original creation of the greatest Artist in (and beyond) history — even though they are deemed precisely worthless to someone who would want to build an interstate highway through this bog.

Second, the eschatology of abandonment is being replaced by an engaging gospel of the kingdom. The phenomenon of evangelical-dispensational eschatology (doctrine of last things or end times) makes perfect sense in the modern world. Understandably, Christians in the power centers of modernity (England in the 1800s, the United States in the 1900s) saw nothing ahead in the story of modernity — nothing but destruction. Their only hope? A skyhook Second Coming,



SUZANNE L. COLLINS, OVAH

Bog Turtle (*Glyptemys mublenbergii*): These tiny turtles (shell lengths usually < 9 cm) have a disjunct distribution throughout the eastern United States. They are federally listed as "threatened" under the 1973 Endangered Species Act and as "endangered" by agencies in states with extant populations.

Opinions expressed are those of the author and may or may not reflect those of the IRCE.

¹ Published originally in *Sojourners Magazine*, March 2004; reprinted with permission from *Sojourners*, 1-800-714-7474, www.sojo.net.

wrapping up the whole of creation like an empty candy wrapper and throwing it in the trash can, and the sooner the better, so God could bring us all to heaven, beyond time, beyond matter, beyond this creation entirely. In this model, virtually no continuity exists between this creation and the new heavenly creation; this creation is discarded like a non-recyclable milk carton. Why get sentimental about a cheap container destined for the cosmic dumpster of nothingness?

This pop-evangelical eschatology made one understandable but serious mistake: It assumed that modernity was all there was or ever would be. Just as the early Christians could not imagine the gospel outlasting the Roman Empire (unless they got the point of the Apocalypse of John), 19th and 20th century evangelicals couldn't imagine the gospel outlasting modernity, the empire of reason, consumerism, and individualism. For pop-evangelical eschatology to proliferate and maintain hegemony, it had to reinterpret the Hebrew prophets. Their prophetic visions of reconciliation and shalom within history (metaphorically conveyed via lions and lambs, children and serpents, swords and plowshares, spears and pruning hooks) had to be pushed beyond history, either into a spiritualized heaven or a millennial middle ground — between history and eternity, so to speak.

The eschatology of abandonment also had to marginalize Jesus (which they did, to a degree, by letting Jesus remain as savior but promoting Paul to master-teacher). But now, as more and more of us rediscover Jesus as master-teacher, we are struck by the centrality of “the kingdom of God” in Jesus' message (and Paul's too). And it is clear to us that this kingdom is not just about heaven after we die: It's about God's will (or wish) being “done on earth” now, in history.

In this kingdom, Jesus said, sparrows matter. Lilies of the field matter. Yes, people matter even more, but it's not a matter of either/or; it's a matter of degree in a world where everything that is good matters — where everything God made matters. God sent Jesus into the world with a saving love, and Jesus sends us with a similar saving love — love for the orphans and widows, the prostitutes and lepers, the poor and forgotten to be sure, but also for the little creatures who suffer from the same selfish greed and arrogance that oppress vulnerable humans.

Third, the hallowed concept of private ownership is being confronted by the biblical concept of stewardship. If liberal Christianity was tempted in the last century to become the civil religion of socialism that reverences state ownership, then certainly conservative Christianity has since become the happy mistress of capitalism that enshrines private ownership. No wonder then that private ownership and private enterprise are defended by many conservative Christians as vigorously as the doctrine of the Trinity or salvation by grace.

For increasing numbers of us who consider ourselves post-liberal and post-conservative, words like private (meaning personal and individual), ownership (meaning autonomous personal and individual control), and enterprise (meaning autonomous, personal, individual control over projects that use God's world for our purposes) seem to fly in the face of kingdom values. Values such as community (meaning seeing beyond the individual to the communal), fellowship (which means sharing, holding in common with the community, not grasping as “mine!”), and mission (meaning our participation in God's projects in God's world for God's purposes).

Can there be some alternative to the extremes that either deny or enshrine private ownership? Could a biblical stewardship that celebrates God's ultimate ownership someday fuel a new grace-based economy — just as private ownership currently fuels our greed-based consumerist economy (or as government ownership fuels a control-based socialist economy)?

A stewardship economy doesn't see every majestic mountain as a potential site for strip-mining operations, nor does it see forests as board-feet of marketable lumber, nor does it see this spring-fed emergent wetland (drained and bulldozed) as a lucrative site for a “housing development” (an unfitting term if there ever was one, since bulldozers and pavement un-develop in hours what it took God's creation centuries to develop). Rather, whatever we “own” (including the molecules and cells that constitute our bodies) is really lent and entrusted to us by God, received by us and reverently used for a time, after which we must let go one way or another — either through giving and voluntary sharing, or through dying and involuntary relinquishing.

So, what do we do differently in this emerging theological habitat, this new stage in the spiritual forest succession? That remains to be seen. But for starters, we see differently, and we care differently, and we value differently — and if those differences catch on, with Christianity being the largest religion in the world, there are bound to be good effects in our world.

Ultimately, those effects will have to go beyond the important but limited conservation actions of individuals (recycling, reusing, abstaining, etc.).

The effects of caring will have to change our systems — transportation systems that depend on fossil fuels and that divide and devastate our nonhuman neighbors' habitats, housing systems that maximize human impact through suburban sprawl, farming systems that violate rather than steward land, advertising systems that make us want more stuff that we don't need and that will soon fill even more square miles with trash. Even our family systems will need reconsideration. For example, we may realize that nuclear family (of so much Christian focus) and “subatomic family” (i.e., the nuclear family further split by divorce) both require (and waste) more resources than the truly traditional family — the extended or “molecular” one. Could extended families and intentional households ever make a comeback? If they do, it will be good news for all of creation — including humans.

Okay. Enough talk. I need to continue my survey. It's one little way as a member of my watershed (one's watershed being one's most important creational address, by the way — more important than nation, state, or zip code) that I can express my care for creation. A care that flows from my identity: a creature who wants to care for other creatures, because I am made in the image of a Creator who cares for us all. I hope you'll find your own ways to express care too, wherever your creational address.

Brian McLaren, founding pastor of Cedar Ridge Community Church in Spencerville, Maryland, is co-author of *Adventures in Missing the Point: How the Culture-Controlled Church Neutered the Gospel* and author of *A Generous Orthodoxy*.

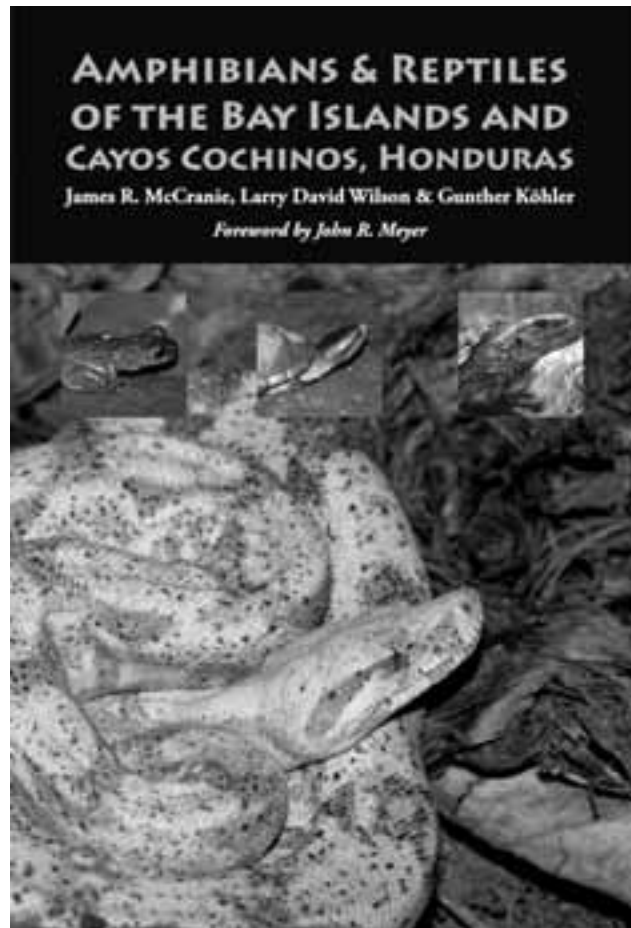
BOOK REVIEW

The Bay Island Herpetofauna Comes to Life

McCranie, J. R., L. D. Wilson, and G. Köhler. 2005. *The Amphibians & Reptiles of the Bay Islands and Cayos Cochinos, Honduras*. Bibliomania! Salt Lake City, Utah. xiv + 210 pp. Hardcover. \$29.95 plus shipping (available at www.herplit.com).

Herpetology in Central America appears to be coming of age. Julian C. Lee's *The Amphibians and Reptiles of the Yucatán Peninsula* (1996) and his *Field Guide to the Amphibians and Reptiles of the Maya World* (2000) were followed in 2002 by two monumental works: *The Amphibians of Honduras* by James R. McCranie and Larry David Wilson and *The Amphibians and Reptiles of Costa Rica* by Jay M. Savage. Then, in 2003, Gunther Köhler published the English edition of his *Reptiles of Central America*, with a foreword by Larry David Wilson. After more than two centuries of scientific collecting expeditions to the region, detailed systematic studies, the description of new species, the publication of monographs devoted to species groups, single genera, and families, finding authoritative, detailed, and well-illustrated summaries of the amphibian and/or reptile faunas of entire political or geographic units is now possible. The latest addition to this burgeoning library is *The Amphibians & Reptiles of the Bay Islands and Cayos Cochinos, Honduras* by McCranie, Wilson, and Köhler.

The Bay Islands are a small archipelago of three major islands (Roatán, Guanaja, and Utila) and a couple of smaller ones, off the northern coast of Honduras. The Cayos Cochinos are a small cluster of two larger and several smaller islands nearer the coast of Honduras south of Roatán. Although they are relatively close to the mainland of Honduras (Utila is only about 32 km from the coast and the Cayos Cochinos only about half that), the islands harbor a surprisingly large number of reptilian species that occur nowhere else. The total herpetofauna consists of 55 species, seven species of amphibians, one crocodylian, five



turtles (three of which are sea turtles), 23 lizards, and 19 snakes. All of the amphibians are anurans (frogs and toads), no salamanders or caecilians occur on the islands.

At first glance, this book seems to be a field guide, and at 6 x 9 in and just over 200 pages, full of species accounts, it looks like one, too — but this is more than a field guide. As for many of the more recently published field guides, the authors follow a brief introduction with a section on Materials and Methods that explains, among other things, how to use the keys in conjunction with the detailed descriptions and photographs in the species accounts to identify the animal at hand. Next is a chapter on the physiography of the Bay Islands in general and each of the major islands individually, a brief overview of the region's climate, and of the nine habitat types found there, including aquatic and urban habitats. Then comes the first pleasant surprise: a chapter on the social history of the Bay Islands and Cayos Cochinos. Like many islands and archipelagos, the Bay Islands have a long history of human habitation. The historical



GUNTHER KÖHLER

Anolis (= *Norops*) *bicaorum* occurs only in hardwood and mangrove forests in the eastern half of Utila.



GUNTHER KOHLER

Boa Constrictors (*Boa constrictor*) are the largest snakes in the islands. A local rumor suggests that Agoutis (large rodents in the genus *Dasyprocta*) on Cayo Cochino Grande became abundant only after 5,000 boas were collected for the pet trade over a two-year period.

background presented in this chapter is a necessary prequel to the concluding three chapters of the book.

The bulk of the book, 137 pages, is occupied by species accounts. Accounts include the common name of each species, in English, Spanish, and/or “corrupted English,” a technical description and mention of similar species that might make identification difficult, a statement of the general geographic distribution and distribution in the Bay Islands and Cayos Cochinos, and a section on natural history. The authors attempted to avoid overly technical terminology, but, where it can’t be avoided, the reader can refer to a very useful glossary. The natural history comments are often much more detailed than those found in most field guides. The serious “herper” will appreciate the inclusion of keys for the identification of species and the photographs. Many species are represented by several photographs, which, as noted in Materials and Methods, can be used with the keys to identify species. Although most of photographs are of specimens found in the islands, some are of animals on the mainland of Honduras or elsewhere in Central America. The pre-publication copy of the book I examined had only black and white renditions of the photographs, all of which will be in color upon publication, so I cannot comment on the quality of the photographs other than to say that they all appear in focus and aesthetically appealing. In addition to the photo-



GUNTHER KOHLER

The gecko, *Phyllodactylus palmeus*, is endemic to the Bay Islands and Cayos Cochinos. Historically abundant in various habitats, including buildings, this species may be affected negatively, especially in edificarian habitats, by the presence of the House Gecko (*Hemidactylus frenatus*; see also IGUANA 11(1), p. 20).

graphs of amphibians and reptiles, the book includes an unusually large number of landscape and habitat photographs, which provide a “feel” for the environment.

Following the species accounts are chapters on ecological distribution and relationships and on biogeographic relationships and their significance. The final three chapters constitute the second pleasant “surprise” in the book in that the topics covered often are omitted or given short shrift in field guides. The first is on the conservation status of the herpetofauna, which is usually relegated to a sentence or two at the end of individual species accounts in other regional guides, and the second is a description of ongoing conservation efforts in the Bay Islands and the Cayos Cochinos. Special emphases in the latter chapter are on efforts to conserve the Utila Iguana (*Ctenosaura bakeri*) and on the Cayos Cochinos Biological Reserve. The text concludes with a forecast for the future of the herpetofauna of the islands, a future that is clouded by habitat destruction and pollution associated with population increases and land development. The book closes with the glossary, an eight-page Literature Cited, and an index to scientific names.



GUNTHER KOHLER

In sharp contrast to boas, the Silver Snake (*Leptotyphlops goudotii*) is the smallest snake in the islands. These diminutive snakes are rarely encountered, mainly because they spend most of their lives under cover or under ground. Like relatives, they probably eat termites or ants.

Between them, the authors of this book probably know more about the amphibians and reptiles of Honduras than anyone, and their expertise is evident. Relatively few North Americans visit the Bay Islands and fewer still get to the Cayos Cochinos, and those who do are most often there to dive ... this is one of the few places in the world where one can fairly reliably encounter Whale Sharks. I hesitate to recommend that you go, because I’d really like to keep the place a secret, but it’s really a wonderful place. If you go, buy this book. Read the chapters on social history, ecology, biogeography, and conservation before you go. You’ll be better prepared for what you’ll see. Take the book with you, not only to help you identify the amphibians and reptiles you will surely encounter, but to learn more about their habits and habitats. Herpetology is much more than just checking off the name of a species on a life list. Even if you can’t visit the Bay Islands, buy this book. Through its photographs, you can take a virtual trip. It’ll be worth it and, at \$30.00, a lot cheaper than the real thing.

Arthur C. (Sandy) Echnernacht
University of Tennessee, Knoxville

CONSERVATION RESEARCH REPORTS

Road Mortality Altering Sex Ratios in Turtles

With an increase in turtle road mortality accompanying the expansion of the road network throughout the United States, affecting mostly females searching for suitable nest sites, GIBBS AND STEEN (2005. *Conservation Biology* 19:552–556) predicted that historical trends in sex ratios of turtle populations would be increasingly male-biased. Using 165 estimates of population-level sex ratios for 36 species (published from 1928–2003), the authors demonstrated that the proportion of males in populations had increased linearly. Populations have become more male-biased in aquatic species, in which movement differentials between males and females are greatest, and are least biased in semiaquatic and terrestrial species, in which overland movements are more comparable between sexes. Their results suggest an ongoing depletion of breeding females from wild turtle populations over the last century.



BRIAN S. EDMOND

Road-killed Common Snapping Turtle (*Chelydra serpentina*) from Hickory County, Missouri. Populations have become more male-biased in aquatic species, because females may wander far in search of nesting sites, whereas males rarely leave the immediate vicinity of water.

Commercial Trade in Amphibians and Reptiles

Amphibians and reptiles are taken from the wild and sold commercially as food, pets, and traditional medicines. Because some species have been over-collected and the United States, unlike most countries, tracks imports and exports of all amphibians and reptiles, SCHLAEPFER ET AL. (2005. *BioScience* 55:256–263) examined records from 1998–2002. This revealed a US trade of several million wild-caught amphibians and reptiles each year, although many shipments were not recorded at the species level. Because

accurate trade and biological information for most species are not available, establishing whether current take levels are sustainable is difficult. The void of information also implies that population declines due to over-collecting could be going undetected.



AILEEN SALZBERG

Detailed and accurate data are not available for most imported species. Establishing whether or not current take levels are sustainable is impossible. Complicating matters is high mortality in many shipments. These flat, stacked boxes, nailed together for shipping, are barely high enough to accommodate animals, which are packed tightly. The “tegues” (= tegus, *Tupinambis* sp.) in this shipment, photographed in the mid-1990s at John F. Kennedy International Airport in New York, did not survive.

Decline in a Population of Wood Turtles in Southern Québec

Wood Turtle (*Glyptemys insculpta*) populations have been declining throughout the species’ range and some populations have been extirpated. DAIGLE AND JUTRAS (2005. *Journal of Herpetology* 39:130–132) used mark-recapture methods to document a 50% reduction over seven years in an agricultural area in southern Québec. Emigration from the area is not likely; instead, increased mortality and poor recruitment probably are responsible for the decline in the turtle population. Increased mortality may be related to increased incidence of roadkills, deaths attributable to farm machinery, burial or crushing by heavy machinery during stream bank stabilization, higher predation pressure, and even poaching. Because of success in finding juveniles in other Wood Turtle populations, the authors did not think the low numbers of young individuals was due to either secretive habits or use of habitats that were not sampled. Thus, the best explanation is poor recruitment. Since apparently suit-



SUZANNE L. COLLINS, CHAH

Wood Turtle (*Glyptemys insculpta*) populations are declining throughout the species’ range.

able nesting sites are available, low nesting success, attributable to increased predation, especially by Racoons (*Procyon lotor*), appears to be responsible.

Conservation Status of the Komodo Dragon

Information on population size and distribution of the Komodo Monitor (*Varanus komodoensis*) is largely restricted to surveys conducted on only part of the species’ range, the most recent of which was conducted in 1971. CIOFI AND DE BOER (2004. *The Herpetological Journal* 14:99–107) noted that populations occur on only four islands in Komodo National Park and on the island of Flores in southeastern Indonesia. Population density estimates for Flores were more than 60% lower than those for islands in Komodo National Park. Habitat fragmentation and poaching of prey species currently represent the main threats to *V. komodoensis*. Protection of monsoon forests in western and northern Flores is crucial for the long-term conservation of the species.



JOE WASILEWSKI

A solitary male Komodo Monitor (*Varanus komodoensis*) on the island of Komodo. Often called “dragons,” these largest living lizards are threatened by habitat fragmentation and poaching of prey species.

Impact of Humans on Savanna Lizard Assemblages

Habitat degradation through over-grazing and wood collection is prevalent in South Africa. Although protected areas have been designated for conservation, little is known about diversity outside these areas. SMART ET AL. (2005. *Biological Conservation* 122:23–31) assessed the impact of land use on lizard assemblages in communal rangelands by comparing abundance, species richness, and species diversity in degraded communal lands and a protected area. Communal lands had fewer large trees and less ground cover, but the authors found no evidence that any species of lizard was negatively affected by habitat disturbance. Some species were more common in communal lands, and species richness and diversity were also higher when using certain sampling techniques. This may have been attributable to the preference of many terrestrial lizards for open, sparsely grassed areas, but reduced numbers of predators and competitors may also have played a role. However, species commonly used by traditional healers were not encountered in field surveys, and local residents indicated that they appeared to be declining.



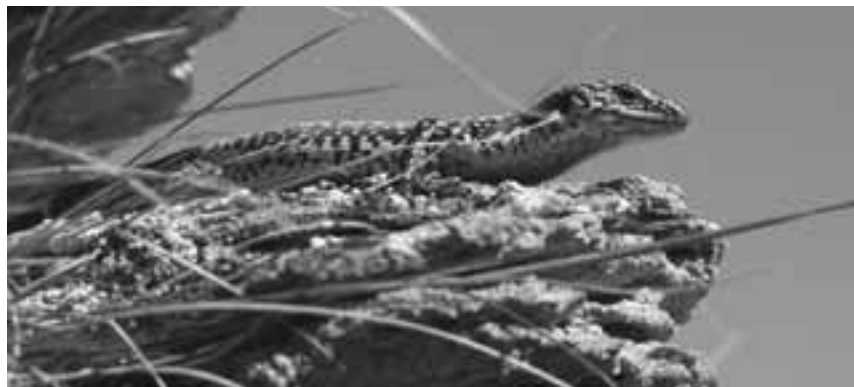
ROSE SADDLER, AUSTRALIAN MUSEUM

The lacertid, *Pedioplanis lineoocellata*, was more abundant in disturbed areas than in a protected area. The species is reasonably common in sparsely vegetated areas throughout much of southern Africa. This specimen is from southern Namibia, near Aus.

Declining Population or Always Rare?

Species that are rare when discovered present a practical management problem because we may not be able to determine whether a taxon is in the final stages of an anthropogenic decline or is naturally uncommon. BERRY AND GLEESON (2005. *Biological Conservation* 123:197–210)

analyzed mitochondrial and microsatellite DNA data to distinguish between these possibilities in a rare lizard from southern New Zealand. Grand Skinks (*Oligosoma grande*) are large, rock-dwelling lizards with a fragmented distribution consisting of a western and eastern cluster of populations separated by about 120 km. This distribution could result from human disturbance, pre-human climatic and vegetation changes, or both. The current situation is likely to have both historical and recent anthropogenic elements. Two eastern populations showed evidence of being historically large, although they are now small, supporting anecdotal data that Grand Skinks have declined in historical times. However, reciprocal monophyly suggests long independent evolutionary histories that predate the arrival of humans. Eastern and western populations fulfill many criteria necessary for consideration as evolutionarily significant units (effectively, species), but such a classification must be balanced against addressing more immediate threats to the species' survival, such as introduced predators.



TRENT BELL

The Grand Skink, *Oligosoma grande*, is restricted to 8% of its former range in Otago, New Zealand due to agricultural development and predator pressure. These endangered skinks live on schist rock outcroppings in the harsh environments of the high country.

Blanding's Turtle in Nova Scotia

Nova Scotia populations of Blanding's Turtle (*Emydoidea blandingii*) are small and disjunct. What was previously thought to be a single panmictic population consists of three discrete groups in two different watersheds. MOCKFORD ET AL. (2005. *Biological Conservation* 123:373–380) identified significant genetic differences in pairwise comparisons between groups. Distance rather than watershed seemed to be the principal determinant. Population simulations suggested that this differentiation likely pre-dated human influence on the local landscape. In the face of rapid environmental changes, understanding



SUZANNE L. COLLINS, GNAH

Significant genetic differences exist between isolated populations of Blanding's Turtles in Nova Scotia.

spatial structure in this population complex is essential for matching management strategies to ecological realities in this long-lived, late-maturing species.

Artificial Lights and Hatchling Sea Turtles

Artificial lighting disrupts the nocturnal orientation of sea turtle hatchlings as they crawl from their nest to the ocean. TUXBURY AND SALMON (2005. *Biological Conservation* 121:311–316) used laboratory experiments in an arena to simultaneously present artificial light (that attracted the turtles toward “land”) and natural cues (a dark silhouette of the dune behind the beach) that promoted “seaward” orientation. Artificial lighting disrupted seaward crawling in the presence of low silhouettes, but not high silhouettes. Low silhouettes provided adequate cues for seaward crawling when the brightness of artificial light was reduced. Based on these results, the authors postulated that artificial light disrupts orientation by competing with natural cues. Current restoration practices at nesting beaches emphasize light reduction. However, at many sites, some lights cannot be modified. The study suggests that pairing dune restoration (to enhance natural cues) with light reduction (to the extent possible) should significantly improve hatchling orientation, even at nesting beaches where lighting cannot be entirely eliminated.



These hatchling Leatherback Sea Turtles (*Dermochelys coriacea*) were photographed using light from a flashlight with a red filter over the lens in order not to disrupt their orientation. Photograph courtesy of the St. Eustatius National Parks Foundation (STENAPA).

Green Bridges

TEUFERT ET AL. (2005. *Zeitschrift für Feldherpetologie* 12:101–109) examined use of the “green bridge” across Autobahn 4 near Bischofswerda (Germany). They documented use of the bridge by three species of amphibians (European Common Toad, *Bufo bufo*; Common Eurasian Spadefoot Toad, *Pelobates fuscus*; European Common Frog, *Rana temporaria*) and three species of reptiles (Viviparous Lizard, *Zootoca vivipara*; Slow Worm, *Anguis fragilis*; Grass Snake, *Natrix natrix*). Most crossings were by *B. bufo* and *Z. vivipara*. The latter especially demonstrated a very high fidelity to appropriate microhabitats, suggesting that the efficacy of green bridges is dependent on maintaining appropriate habitat structure on the bridge and in areas to either side.



GUNTHER KÖHLER

Species that are known to use the “green bridge” near Bischofswerda: The Viviparous Lizard (*Zootoca vivipara*, male and female) and the Slow Worm (*Anguis fragilis*).

Buffer Zones

The preservation of riparian taxa often requires the preservation and manage-

ment of buffer zones around riparian areas. ROTH (2005. *Copeia* 2005: 399–402) tested this assumption using radio-telemetry to examine the spatial distribution of male, gravid female, and non-gravid female Cottonmouths (*Agkistrodon piscivorus*) in a stream/riparian habitat in Texas. Over 80% of all observations were within 10 m of the stream. However, gravid females were most frequently found farther away, up to 94 m from the shoreline. The author concluded that disturbances to the terrestrial areas surrounding the riparian habitat would have a disproportionate effect on gravid females, potentially affecting the reproductive capacity of the population. This study reinforces the importance of buffer zones and consideration of spatial use differences between population subunits when developing management plans.



BRIAN D. GREENE

Cottonmouths (*Agkistrodon piscivorus*) usually are associated with streams. However, especially gravid females may move some distance from the stream, indicating a need to maintain sufficient buffer zones when conserving riparian habitats. Adult in defensive posture (top), showing the white oral lining from which the common name is derived; juveniles (bottom) are much more distinctly patterned and retain a yellow tail through several sheds.

NEWSBRIEFS

Absence of Lesser Antillean Iguanas on Île Forchue

After an extensive search, Karl Questel, from St.-Barthélemy, reports an absence of Lesser Antillean Iguanas (*Iguana delicatissima*) on the Island of Fourchue, despite the presence of appropriate food plants such as Prickly Pear (*Opuntia* sp.) and young Black Wood. He was unable to search Forchue's tiny neighboring islands of Petite Islette and Île-au-Vent, where researcher Michel Breuil had reported the presence of iguanas during investigations in 2000 and 2001.

Dogs Track Burmese Pythons in Everglades National Park

Wildlife Biologists in Everglades National Park are training a beagle named "Python Pete" to assist in a targeted eradication of Burmese Pythons (*Python molurus*). The Pythons, dumped in the park by pet owners who can no longer manage the massive snakes, can reach 6 m in total length and are thriving in the Park. Authorities fear that the snakes will prey on endangered birds and other endemic wildlife. Unlike many of the invasive plant and animal species in the park, scientists believe that the Burmese Python population is small enough that it can be eliminated with intensive intervention. A clear sense of urgency exists, however, given evidence that the snakes have been breeding. Sixty-one Pythons were caught and killed in 2004, and 15 have already been taken in January 2005. Aside from the tracking skills of Pete, who is being trained to follow scented trails, the targeted eradication program also makes use of a hotline for reporting sightings and a preventative education program aimed at pet stores and exotic reptile organizations with the slogan "don't let it loose."

Iguanas Eat at Airport

Landscapers at Simon Bolivar International Airport in Guayaquil, Ecuador are faced with a problem: the grounds are being overrun by Green Iguanas. Dr. José Luis Silva, has appealed to the IUCN Iguana Specialist Group for ideas on how to keep the iguanas away



KARL QUESTEL

This very large adult Lesser Antillean Iguana (*Iguana delicatissima*) lives in one of the more inaccessible and uninhabited uplands on St.-Barthélemy. Despite intense development, primarily for the tourist trade, the island supports a population of iguanas. Unfortunately, those not protected by private land owners or by living in remote areas, are vulnerable to poaching, and feral and domestic cats kill many juveniles, precluding effective recruitment.

from ornamental plants without harming the animals. Ironically, the city of Guayaquil is home to the aptly named "Parque de las Iguanas," a public park that has become a favorite tourist destination. Trees in the park are filled with Green Iguanas and visitors come to admire and feed them.



JOHN BINNS

Green Iguanas (*Iguana iguana*) may wreak havoc with ornamental vegetation.

Lizards Banish Rats from Rat Island

Scientists from the Durrell Wildlife Trust in Jersey aim to create a rodent-free refuge on Rat Island, a small Caribbean island off the western coast of St. Lucia,

in order to save one of the world's rarest creatures: the St. Lucia Whiptail Lizard (*Cnemidophorus vanzoi*). The Rat Island project involves a team of conservation workers who, in early February, began laying down blocks of waxy poison in a grid across the little island off of St. Lucia. They will return in March in order to conduct tests to make sure all of the rats are dead. Only when all of Rat Island's rats have been killed will breeding whiptails be introduced to colonize the island.

For hundreds of years, European ships have carried rodent stowaways across the world, where they have estab-



MATT MORTON

Critically endangered St. Lucia Whiptail (*Cnemidophorus vanzoi*).



BRIAN S. EDMOND

Playing on the public's fear of snakes, SnakeSnare intentionally promotes the killing of harmless and often useful snakes, such as this Common Garter Snake (*Thamnophis sirtalis*) from Holt County, Missouri.

lished thousands of strongholds. Many efforts to deal with the problem have only made matters worse. When the sugarcane plantations of St. Lucia and other Caribbean islands became plagued with rats, landowners introduced the mongoose (*Herpestes javanicus*) to kill them. Unfortunately, the mongoose is active during the day and rats are nocturnal. Contact between them is minimal and they happily coexist — only now the mongoose, in addition to the rats, is decimating native island populations of birds and reptiles.

Rat removal, such as that on Rat Island, is not a one-time solution. Increasingly, conservationists are turning to small offshore sites in hopes of creating preserves in which threatened creatures might find sanctuaries.

Adapted from a story by Robin McKie, Science Editor, *The Observer*, originally published on 13 February 2005; <http://observer.guardian.co.uk/international/story/0,6903,1411804,00.html?gusrc=rss>

Snake Snares Decapitate

A company called SnakeSnare, LLC, in Iowa has designed a device that is intended to intentionally decapitate wild snakes. The company's website promotes use of the snare in residential areas and on golf courses, "where gunfire is impractical or illegal," citing the old adage that "a good snake is a dead snake." Concerned about the marketing pitch promoting the extermination of wild snakes, Dean Alessandrini, Vice-

President of the Greater Cincinnati Herpetological Society, suggests checking their website (www.snakesnare.com) and voicing your concerns.

Giant Garter Snake Habitat Sought

After years of improperly filling wetlands at the airport, federal wildlife regulators have ordered the Sacramento International Airport to purchase alternative wetland habitat for Giant Garter Snakes (*Thamnophis gigas*). The species is listed as threatened and protected by the U.S. Endangered Species Act. In competition for the purchase of 300 undeveloped



ROBERT W. HANSEN

Threatened Giant Garter Snakes (*Thamnophis gigas*) may gain some wetland habitat courtesy of the Sacramento International Airport.

acres in northern Sacramento and southern Sutter counties, land that commercial developers also are seeking as mitigation for construction elsewhere, the airport may end up paying more than \$11 million.

Sacramento Business Journal

2005 Turtle Survival Alliance General Meeting Announcement

The 2005 IUCN/Turtle Survival Alliance General Meeting will be held 22–24 July 2005 at the Mission Valley Resort Hotel in San Diego, California. Don Boyer, San Diego Zoo, is serving as the Conference Committee Chairman. The meeting will run approximately from 8–5 on Saturday and Sunday with a lunch break. A trip to the San Diego Zoo is scheduled on Saturday evening. Following a buffet dinner, participants may visit the zoo grounds until 10 pm. Stragglers will be fed to the tortoises.

Papers and posters will be presented in three general areas: (1) Graduate Research (Brian Horne, briandhorne@hotmail.com, and Patrick Baker, bakerpj@hotmail.com), and



muohio.edu, chairs), (2) Captive Husbandry (Fred Caporaso, caporaso@chapman.edu, and Chris Hagen, hagen@srel.edu, chairs), (3) International Conservation & Field Research (Rick Hudson, rhudson@fortworthzoo.org, and Dwight Lawson, dlawson@zooatlanta.org, chairs). Talks and posters focusing on captive breeding, nutrition, *in situ* conservation plans, range country education programs, population surveys, genetics, trade observations, legislative priorities, facility management and design, contagious diseases, and quarantine are encouraged. Titles and brief descriptions of papers are due by 15 April, although submission of a title, abstract, or paper does not guarantee acceptance for presentation. Presenters will be notified of the status of their proposal by 15 May. After contacting Session Chairs, submit papers or abstracts to Chuck Schaffer, Conference Program Chair (904-220-0678, chelonian1@aol.com, 13811 Tortuga Point Drive, Jacksonville, FL 32225).



ROBERT POWELL

Hawaiian Green Sea Turtle (*Chelonia mydas*) swimming off Kauai.

National Award for Turtle Studies

The National Wildlife Federation's Conservation Achievement Award has been awarded to Hawaiian NOAA Fisheries biologist George Balazs for his work on the threatened Hawaiian Green Sea Turtle (*Chelonia mydas*), which he helped place on the federal endangered species list in 1978. The population has recovered significantly since that time and Balazs's radio-tagging studies have shown that the turtles can take long open-ocean routes from their feeding sites to nesting areas and that they can navigate hundreds of miles from the main Hawaiian Islands to nesting beaches in the northwestern Hawaiian Islands without landmarks.

Honolulu Advertiser

Rattlesnake Roundup:

Spectator Sport or Animal Cruelty?

The Taylor rodeo grounds, outside Sweetwater, Texas, are home to one of 28 annual rattlesnake roundups in the United States each year. This year's gathering is billed as the 33rd Annual National Rattlesnake Sacking Championship, and the main event is a race against the clock to see which two-man team is the fastest to pitch 10 snakes into a burlap bag. About 80 Diamondback Rattlesnakes (*Crotalus atrox*) squirm on a plexiglas stage, trying to hide underneath each other while handlers incite them to strike and rattle for onlookers.



Rattlesnake roundups have a long history, attract lots of people, set foolish examples of how to safely handle potentially dangerous animals, and typically provide highly misleading information about snakes in general and rattlesnakes in particular. Photograph courtesy of APNM.org.



SUZANNE L. COLLINS, CMAH

The Plains Blackhead Snake (*Tantilla nigriceps*) may or may not be present or even widely distributed in Wyoming.

Andrea Cimino, wildlife campaign coordinator for the Humane Society of the United States says, "The roundups are extremely cruel, but people can ignore the cruelty because a reptile can't scream." Some biologists suggest that the roundups could be depleting snake populations; however, the Western Diamondback Rattlesnake seems to be plentiful in Texas according to the Texas Parks and Wildlife Department. Ken Garrett, member of the winning team, which bagged ten snakes in 30.75 seconds, says, "I'm a hunter. I believe in man's dominion over all animals. The snakes are there for the use of man."

After the roundup, the snakes are packed into plywood boxes and hauled off by a snake dealer who sells them for snake kebabs, coin purses, and cell phone cases.

Los Angeles Times

Search for a Shy Serpent

He's very shy; loves to eat small frogs, very small dead fish, and the occasional centipede; and has been known to hide under cow pies on warm summer days. The problem is, he has officially been seen only one time in Wyoming, way back in 1985, and scientists aren't sure if he's even around anymore.

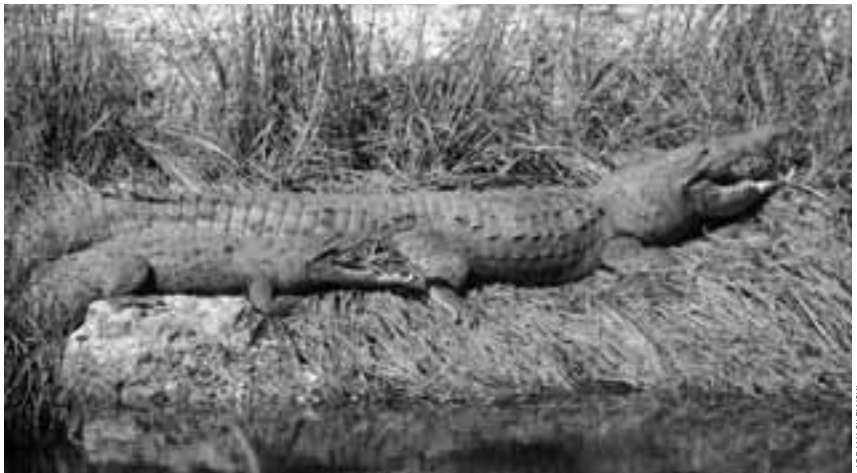
So, Wyoming Game and Fish Department officials are asking for the public's help in gathering more data about the possible numbers and distribution of the tiny but mildly venomous Plains Blackhead Snake. "They're very, very secretive ... but then again we haven't had a whole lot of people looking for it," said herpetologist Bill Turner, a Game and Fish reptile/amphibian biolo-

gist. “We’re curious to know if it’s widespread, if they’re uncommon throughout the state or if they’re just peripheral to the state,” he said. “We’re trying to get the public to help us out, because this is an animal that we’ve had only one sighting of in the state so far.”

Game and Fish officials say although there are about 40 reptile and amphibian species in the state, biologists have little or very limited information on most of the species. “One example of species we need to know more about ... is the Plains Blackhead Snake,” Turner said. He said the reptile’s population status is currently “unknown” in Wyoming. Turner has recently been working with scientists and other biologists to learn more about Wyoming’s reptiles and amphibians. The effort is part of a larger department initiative to help preserve those nongame species with the greatest conservation needs.

The Plains Blackhead Snake was first found in Wyoming in August 1985 — near Glendo Dam in east-central Wyoming — by two eminent herpetologists, Ellen Censky and C. J. McCoy, during a “typical collecting run” through Wyoming, Turner said in a phone interview. The pair wrote an article about the discovery, which was the first official documentation of the species, he said. Turner said while the article was being printed, another important book on Wyoming herpetology — “Amphibians and Reptiles of Wyoming,” by the late George Baxter and Mike Stone — was also published. But the Plains Blackhead Snake was omitted from the Baxter/Stone book, which later became the preferred reference for herpetology in the state. Turner said since then, the snake has been largely overlooked by scientists.

The snake has grooved teeth in the rear of its mouth. Turner said some scientists think the fangs help inject toxic saliva into its prey. “When we say venomous, that’s just the venom in its saliva... It’s a tiny snake, and the primitive injection system poses little or no threat to humans,” he said. Turner said if the Plains Blackhead Snake is discovered again in the state, it would mean Wyoming has two venomous snake species. The other is the Western Rattlesnake, with its subspecies — the Midget Faded Rattler and the Prairie Rattler.



A pair of American Crocodiles (*Crocodylus acutus*) thermoregulating on a canal bank in South Florida, the northernmost extent of the species’ range.

Turner was hired in 2003 by the Game and Fish Department to be the agency’s first herpetologist, according to Walt Gasson, the agency’s special planning coordinator. He said the department used federal funding from the State Wildlife Grants program to hire Turner. In 2001, Congress established the program to provide funding for states to help conserve species of greatest conservation need. Through September 2004, the state received almost \$2 million in SWG money. Gasson said the department is in the process of writing a comprehensive wildlife conservation strategy to continue receiving the federal funding. He said while the department is charged with conserving all wildlife, limited funding has sometimes hampered efforts to manage nongame species such as the Plains Blackhead Snake.

Jeff Gearino (*Star-Tribune*, Jackson Hole, Wyoming) 10 May 2005

Proposed Downlisting of American Crocodiles

The U.S. Fish and Wildlife Service reports that annual monitoring of the American Crocodile (*Crocodylus acutus*) in Florida indicate that the criteria for reclassification (the number of nests and nesting females) from endangered to threatened have been achieved. The Service also proposes to initiate a five-year review of population data, ongoing conservation measures, and other factors affecting the species.

Since 1975, when the crocodile was protected under the Endangered Species

Act, its numbers in Florida have grown from fewer than 300 individuals (with only an estimated 10 to 20 nesting females) to an estimated 500–1,000 individuals (and more than 61 nests), not including hatchlings. Approximately 95% of remaining crocodile habitat in southern Florida has been acquired by federal, state, and county agencies and is now protected from development. These protected areas should allow the crocodile population to expand and may provide additional nesting opportunities. If this proposal is finalized, the American Crocodile in Florida will continue to be federally protected as a threatened species.

The American Crocodile, a large greenish-gray reptile, ranges in size from a little more than 25 cm at hatching to a maximum length of about 3.8 m. It is one of two native crocodylians (the other, the American Alligator, *Alligator mississippiensis*) that occur in the continental United States. The American Crocodile is distinguished from the American Alligator by a relatively narrow, more pointed snout and by an indentation in the upper jaw that leaves the fourth tooth of the lower jaw exposed when the mouth is closed.

The American Crocodile is found in coastal regions of the Atlantic and Pacific coasts, southern México, Central America, and northern South America, as well as some Caribbean islands. In the United States, the crocodile is limited in distribution to the southern tip of mainland Florida and the upper Florida Keys. The American Crocodile remains endangered throughout the remainder of its range outside of the United States.

CONSERVATION NEWS

The Phantom of the Swamp

IVORY-BILLED WOODPECKER, *CAMPEPHILUS PRINCIPALIS*

By William Marshall Pulliam



For those who don't understand why, in these days of extinction everywhere, the resurrection of some "bird thing" is so noteworthy, I offer this:

The Ivorybill is not just a swamp bird — it is *the* Swamp Bird. Even more than 'gators and Bald Cypress, it is the very embodiment of antiquity, wildness, remoteness, the primeval mystery of the deep dark woods and waters. The very name carried magical, spiritual significance, like dragons or centaurs. Like the other magical creatures, they vanished when civilization entered their realm. The Ivorybill became metaphor for everything that technology and settlement had driven away, into the farthest recesses of the wilderness or even entirely from the face of the planet. A swamp "deep enough for Ivorybills" was one that was entirely beyond human influence. They became a phantom, a rumor, something in which no rational people were supposed to believe. By the 1970s, searching for Ivorybills was viewed with nearly the same eye as searching for

Bigfoot. Someone who claimed a sighting of one was likely to be treated worse than someone who reported seeing a UFO. The Ivorybill's status became almost godlike — and rational scientists aren't supposed to believe in gods.

But the stories persisted. Hunters, mostly, and the occasional boater told mysterious and intriguing tales; but no one could confirm, no one could produce a photograph, a recording, a feather, even a flake of wood that was unequivocal. Just a few years ago, what seemed to be a very promising lead in extreme southwestern Mississippi was finally taken seriously and pursued actively — but it was more of the same: hints, tantalizing signs, unusual noises, but in the end ... nothing. The failure of the Pearl River expedition after such promising signs was a serious blow to us few hopeful holdouts.

And so comes along Mr. Sparling in his kayak and the huge red-crested woodpecker with the big white spot on its back that landed on a tree in front of him some 14 months ago. A year of follow-up and amazingly well-kept secrecy — and then the announcement. A dragon is perched on top of the Empire State building, Elvis calls a press conference to apologize for having been away so long, a flock of Thunderbirds circles Mount Rushmore and they are pecking George Washington's eyes out, and the Lord God Woodpecker is happily cruising the swamps of Arkansas.

Anything can happen.

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Editors' Remarks

We hope that you have enjoyed the first two issues of *IGUANA* published by the International Reptile Conservation Foundation (IRCF). Although this current issue is unusually long, we do plan to continue bringing you full-length articles in addition to the regular features that include: an article on husbandry, a profile of a prominent conservationist/herpetologist, a travelogue about a herpetologically interesting destination, a historical perspective giving a glimpse of herpetology in years past, a commentary, a book review, summaries of articles in other journals that address issues pertinent to the conservation of reptiles, newsbriefs, and a focus on conservation highlighting a project worthy of your support. From time to time, we may include short (2–3 page) articles or special features like the essay on the rediscovery of the Ivory-billed Woodpecker, which appears in this issue. Also, because we are interested in your thoughts and comments, we plan to occasionally publish selected letters from readers and, if those letters include questions, we'll do our best to respond in a thoughtful and informative manner.

As you can imagine, this rather ambitious agenda has stretched us to our limits. The two of us and John Binns, who processes all images that appear in *IGUANA*, are familiar to most readers, and many of you have showered us with compliments regarding some of the changes that have taken place over the past couple of years. However, the member of our team who rarely is acknowledged, but without whom we wouldn't be where we are today, is Mike Ripca. Mike, our art director, assembles a myriad of pieces into the journal with which you are familiar, provides us and authors with proofs, makes corrections (many of them our fault) without complaining, and then does it all again a couple of months later. Mike, our hat's off to you.

Robert Powell and AJ Gutman

JOIN ON-LINE AT: www.IRCF.org

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Solicitations

The IRCF encourages contribution of articles, letters to the Editor, news items, and announcements for publication in *IGUANA*. General articles can deal with any aspect of reptilian 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 AJ@IRCF.org). Authors of one page or more of print will receive a free copy of the journal in which their contribution appears, and will receive a PDF file of their article for distribution.

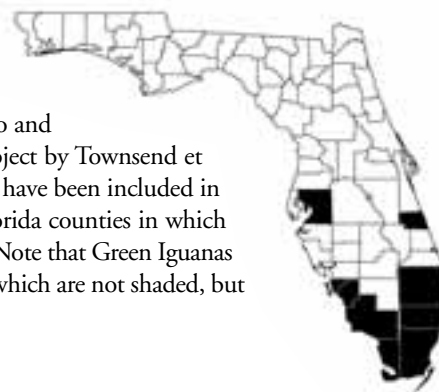
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ERRATUM: The map of southern Florida on p. 160 in the article on introduced Green Iguanas (*Iguana iguana*) by Meshaka et al. (2004. *IGUANA* 11(3):154–161) was incorrect. The uncredited map shown was by Kenneth L. Krysko and indicated localities mentioned in an article on a similar subject by Townsend et al. (2003. *IGUANA* 10(4):111–118). The map that should have been included in the article by Meshaka et al. is shown here. It illustrates Florida counties in which breeding populations of Green Iguanas are known to occur. Note that Green Iguanas have been recorded from Highlands and Alachua counties, which are not shaded, but iguanas in those counties do not appear to be reproducing.



Statement of Purpose

The International Reptile Conservation Foundation works to conserve reptiles and the natural habitats and ecosystems that support them.

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FOCUS ON CONSERVATION

Fijian Crested Iguana (*Brachylophus vitiensis*)



PETER HARLOW

The only true iguanas found outside the Americas are the two species of Pacific iguanas, which are restricted to the islands of Fiji and Tonga in the southwestern Pacific. Both are arboreal herbivores that feed on the leaves, flowers, and fruits of native trees and shrubs. The critically endangered Fijian Crested Iguana (*Brachylophus vitiensis*) is today secure on only one small, uninhabited island, the 70-hectare Crested Iguana Sanctuary island of Yadua Taba, administered by the National Trust of the Fiji Islands. Populations on most other islands appear to be functionally extinct, with little or no juvenile recruitment. The threatening processes that have contributed to the species' decline continue unchecked (native forest degradation from clearing, burning, proliferation of invasive plants, and over-grazing by goats, as well as the introduction of cats and mongooses).

The World Conservation Union's Iguana Specialist Group met in Fiji in November 2004 to address this species' conservation requirements and produce a conservation and management plan. Priorities include identifying islands suitable for the species' long-term survival, collecting urgently required natural history data to aid conservation planning (especially on diet and reproduction, of which nothing is known), and initiating captive breeding with animals from populations other than Yadua Taba.

The uninhabited island of Monuriki was identified as the first choice for sourcing Crested Iguanas for a second captive breeding group. Monuriki is a spectacular island, its Crested Iguanas are genetically distinct from Yadua Taba, and its location close to a major tourist area provides an excellent potential for future ecotourism. The native forest, however, has been severely degraded by fires, intensive goat grazing, and invasive plants. Iguana surveys suggest that the population on Monuriki has decreased from an estimated 80–120 iguanas in 1998 to 10–20 in 2003, with no evidence of juvenile recruitment during that time.

Kula Eco Park, Fiji's only center for captive breeding of endangered species, has volunteered to set up the Monuriki captive breeding group, while zoos in Australia will continue captive breeding of iguanas from Yadua Taba. The rationale is that Monuriki Crested Iguanas will soon be (or perhaps already are) functionally extinct; but, if enough founders remain and can be brought into captivity, their progeny could be returned to Monuriki when habitat restoration (or goat exclusion fencing) is completed.

For more information on the Fijian Crested Iguana see *IGUANA* 11(4), December 2004, "Lost in the South Pacific: The Fijian Iguanas (Genus *Brachylophus*)" by Peter Harlow. You also may visit the websites of Kula Eco Park (www.fiji-wild.com) and the International Conservation Fund for the Fijian Crested Iguana (www.icffci.com).



Artwork by Joel Friesch (see profile on p. 108).



Many Lesser Antillean reptiles, like this *Anolis sabaensis* from Saba, are ecologically versatile and have adapted well to human alterations of their habitats. Some, however, are affected dramatically by habitat alterations and destruction and the introductions of alien predators and competitors (see article on p. 62).