

IRCF

# REPTILES & AMPHIBIANS

CONSERVATION AND NATURAL HISTORY

VOL  
16  
NUM  
1  
MAR  
2009







JESSE L. GRISMER

*Leiolepis triploida* is an all-female, asexually reproducing species associated with disturbed habitats in peninsular Malaysia (see article on p. 2).



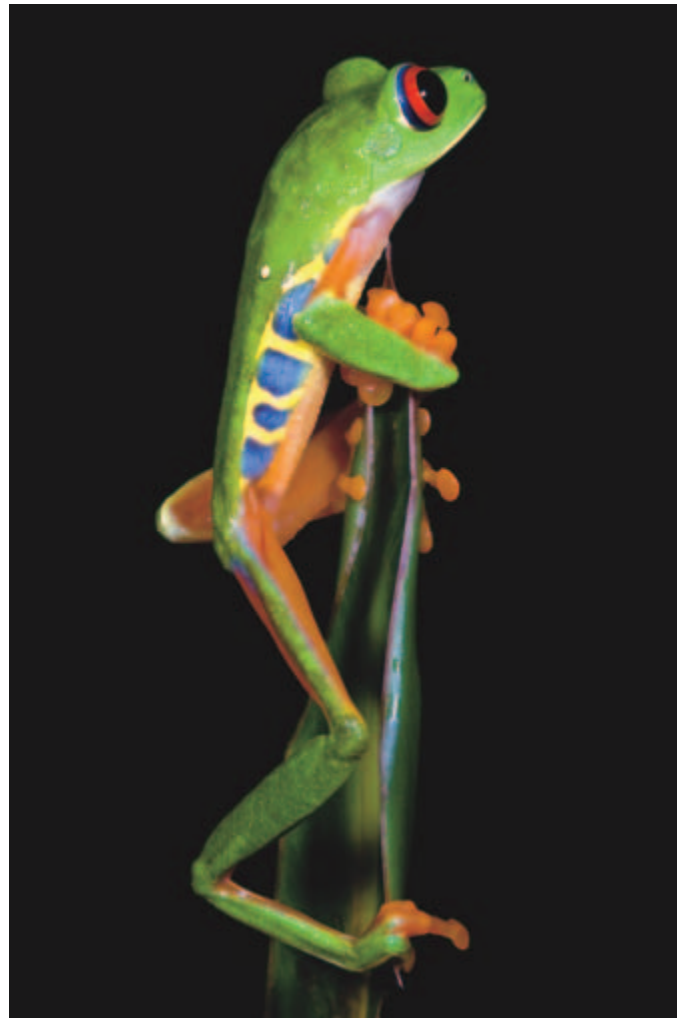
JOHN EMMIS

Newly designated protected land enhances the Grand Cayman Blue Iguana's (*Cyclura lewisi*) chance for survival (see Conservation News on p. 38).



LESTER MELENDEZ

*Abronia fimbriata* is one of eight species of arboreal alligator lizards endemic to Guatemala (see article on p. 24).



BRAD WILSON

Red-eyed Treefrogs (*Agalychnis callidryas*) are iconic and often are used to promote conservation or travel to exotic locales (see Conservation Alert on p. 30).



ADAM CRANE

Hellbenders (*Cryptobranchus alleganiensis*), the largest salamander in North America, are in decline (see article on p. 18).



IRCF  
REPTILES & AMPHIBIANS  
CONSERVATION AND NATURAL HISTORY

TABLE OF CONTENTS

FEATURE ARTICLES

- Battle of the Sexes: Asexuality versus Sexuality ..... *Jesse L. Grismer* 2
- The Herpetofauna of Guana Island: An Annotated Checklist and Travelogue ..... *Gad Perry and Robert Powell* 6
- Saving a Giant Salamander ..... *Alicia Mathis and Adam Crane* 18
- Arboreal Alligator Lizards in the Genus *Abronia*:  
Emeralds from the Cloud Forests of Guatemala ..... *Daniel Ariano-Sánchez and Lester Melendez* 24
- Turning the Tables: Lizard Eats Snake ..... *Alfredo D. Colón Archilla* 28

CONSERVATION ALERT

- Beyond 2008 “Year of the Frog”: The Challenges Facing Amphibians and the Amphibian Ark ..... *Ron Gagliardo* 30

CONSERVATION NEWS

- One Species That Will Be Saved: The Grand Cayman Blue Iguana ..... *Fred Burton* 38

TRAVELOGUE

- Madagascar ..... *Seth Rudman* 42

PROFILE

- John Iverson: Researcher, Teacher, Friend ..... *Lynne Pieper, Stesha Pasachnik, and Kirsten Hines* 48

BOOK REVIEW

- *Animals Make Us Human: Creating the Best Life for Animals* by Temple Grandin and Catherine Johnson ..... *AJ Gutman* 54

Advertisements ..... 55

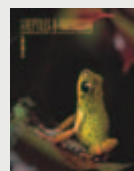
❖ CONSERVATION RESEARCH REPORTS: Summaries of Published Conservation Research Reports ..... 56

❖ NATURAL HISTORY RESEARCH REPORTS: Summaries of Published Reports on Natural History ..... 57

❖ NEWSBRIEFS ..... 58

❖ EDITORIAL INFORMATION ..... 63

❖ FOCUS ON CONSERVATION: A Project You Can Support ..... 64

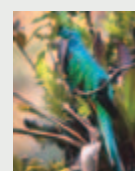


Front Cover: Ron Holt

Habitat loss and unsustainable collection for the pet trade are threatening populations of the Central American Strawberry Poison Frog (*Oophaga pumilio*). See Conservation Alert on p. 30.

Back Cover: José Yee

A Resplendent Quetzal (*Pharomachrus mocinno*) with an arboreal alligator lizard (probably *Abronia fimbriata*), one of the very few records of predation on these little-known lizards. See article on p. 24.







The Butterfly Agamid Lizard (*Leiolepis belliana*) remains locally abundant in remnant natural forests in peninsular Malaysia.

## Battle of the Sexes: Asexuality versus Sexuality

Jesse L. Grismer

Department of Biology, Villanova University, Villanova, Pennsylvania 19085 USA

Photographs by the author.

From the time of Aristotle, naturalists and evolutionary biologists have been intrigued with the origins of species and their life histories. The discovery of asexual lineages opened the door to a new chapter of evolutionary biology that is still not completely understood. The evolution of this unique reproductive lifestyle has perplexed biologists for years. Among vertebrates, lizards contain the highest number of asexual species. Two major pathways have been proposed for the origins of asexuality in lizards: (1) a genetic mutation (usually within a single egg clutch) results in individuals that have the ability to clone themselves, and (2) two sexual (or sometimes a sexual and an asexual) species hybridize to create a polyploid (multiples of the “normal” number of chromosomes), all-female population that has the ability to clone itself (Cole 1975; Cole et al. 1983, 1988; Dessauer and Cole 1989; Reeder et al. 2002). However, only the second pathway has been supported by empirical evidence. Although asexuality is rare among lizards, one of the best-studied cases concerns North America teiids of the genus *Aspidocelus* (Racerunners or Whiptails), in which two sexual species hybridized at the intersection of two major habitat types. This resulted in a polyploid, all-female, asexual population in what is usually a relatively narrow ecotone (boundary between habitats). However, one plum remaining to be picked from the tree of herpetological sexuality deals with a group of relatively understudied lizards from southeastern Asia.

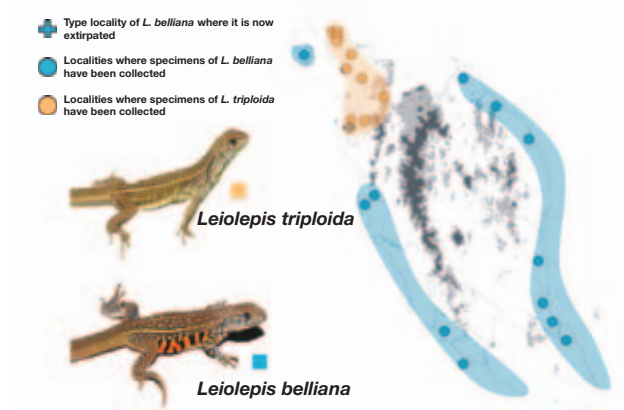
The Southeast Asian Butterfly Lizard genus *Leiolepis* contains seven species comprising the monotypic family Leiolepididae (Townsend et al. 2004). *Leiolepis* has a wide, continuous distribution ranging from Myanmar and China south through the Malay Peninsula (Peters 1971). *Leiolepis* is the only acrodont lizard group in which parthenogenesis (production of a viable embryo without an egg being fertilized) has evolved, with three species consisting of all-female populations. All *Leiolepis* are large (snout-vent length to 18 cm) diurnal omnivores that generally inhabit coastal vegetation, but will follow riverbanks and flood plains into continental interiors.

What is it about the evolutionary history of Butterfly Lizards that predisposed them to switch to an asexual mode of reproduction, and does parthenogenesis have an advantage over sexuality in certain habitats? Given the disjunct distribution of the three asexual species (*L. guentherpetersi* from central Vietnam, *L. boehmei* from southern Thailand, and *L. triploida* of northwestern peninsular Malaysia), parthenogenesis probably evolved independently in each species. Schmitz et al. (2001) addressed the maternal origin of the triploid asexual *L. guentherpetersi* and demonstrated that it had arisen through a hybridization event in central Vietnam involving the two bisexual species *L. reevesii* and *L. guttata*. However, the origins of *L. boehmei*,

a diploid (Aranyavalai et al. 2004, Darevsky and Kupriyanova 1993), and *L. triploida*, a triploid (Peters 1971), are still mysteries.

The only species of *Leiolepis* in peninsular Malaysia are *L. triploida* (found in disturbed habitat) and *L. belliana* (in disturbed and natural habitats). Data from museum specimens and the literature indicate that, prior to 1920, *L. belliana* was the only *Leiolepis* in peninsular Malaysia. After 1920, however, *L. triploida* appeared at various localities in northwestern peninsular Malaysia and no new records for *L. belliana* were recorded.

In 2007 and 2008, I visited each of the localities from which *L. belliana* had been reported prior to 1920 and confirmed that the species was no longer present, and *L. triploida* is the only species to be found. More interestingly, I realized that *L. triploida* occurred only in highly disturbed habitats. On a hunch, I looked at the history of



The current distributions of *Leiolepis belliana* and *L. triploida* in peninsular Malaysia.



An oil palm plantation in the karst formations of northwestern peninsular Malaysia. *Leiolepis triploida* occurs only in this type of habitat.





A female *Leiolepis belliana*, a “normal” diploid species largely displaced from disturbed habitats by asexual *L. triplioda*.



A male *Leiolepis belliana*; unlike asexual *L. triplioda*, males consume resources without contributing offspring.



*Leiolepis triplioda* is an all-female, asexually reproducing species.

agriculture in the area and discovered that Malaysia underwent an agricultural boom in the late 1920s, during which large tracts of natural vegetation were cleared to plant oil palms and rubber trees. Suspiciously, this agricultural expansion occurred at the same time that *L. triplioda* began appearing in museums, and it encompassed the same localities from which *L. triplioda* was being collected.

My hypothesis is that, following the agricultural boom of the late 1920s, *L. triplioda* was able to expand its range, largely displacing *L. belliana* from disturbed habitats. In fact, *L. belliana* can occasionally be found in disturbed habitats — but only where *L. triplioda* is absent. This is in accord with current research on other groups that has demonstrated that asexual species can colonize an environment with just a single individual, and that they tend to flourish in habitats that are unsuitable for sexual species to which they are closely related (e.g., Kearney 2005, Wright and Lowe 1968). The first of these attributes clearly reflects their two-fold reproductive advantage over sexual species. None of their progeny are males that use resources but do not produce offspring. Instead, they produce only females that can clone themselves. The underlying explanation for their success in apparently marginal habitats remains more elusive, but might, as in the American Whiptails, be attributable to an ecological diversity emanating from an ancestry of two species occupying different ecological niches. The next pieces of this puzzle and the focus of my current research are to identify the parental species of *L. triplioda* and to investigate whether or not the species' origin may have played a role in its ability to colonize disturbed areas and displace competitors.

#### Literature Cited

Aranyavalai, V., K. Thirakhuat, P. Pariyanonth, and W. Chulalaksananukul. 2004. Karyotype and unisexuality of *Leiolepis boehmei* Darevsky and Kupriyanova,

1993 (Sauria: Agamidae) from southern Thailand. *Natural History Journal of Chulalongkorn University* 4(1):15–19.

Cole, C.J. 1975. Evolution of parthenogenetic species of reptiles, pp. 340–355. In: R. Reinboth (ed.), *Intersexuality in the Animal Kingdom*. Springer Verlag, Heidelberg, Germany.

Cole, C.J., H.C. Dessauer, and C.R. Townsend. 1983. Isozymes reveal hybrid origin of Neotropical unisexual lizards. *Isozyme Bulletin* 16:74.

Cole, C.J., H.C. Dessauer, and G.F. Barrowclough. 1988. Hybrid origin of a unisexual species of whiptail lizard, *Cnemidophorus neomexicanus*, in western North America: New evidence and a review. *American Museum Novitates* (2905):1–38.

Darevsky, I.S. and L.A. Kupriyanova. 1993. Two new all-female lizard species of the genus *Leiolepis* (Cuvier, 1829) from Thailand and Vietnam. *Herpetozoa* 6:3–20.

Dessauer, H.C. and C.J. Cole. 1989. Diversity between and within nominal forms of unisexual teiid lizards, pp. 49–71. In: R.M. Dawley and J.P. Bogart (eds.), *Evolution and Ecology of Unisexual Vertebrates*. New York State Museum Bulletin No. 466, Albany.

Kearney, M. 2005. Hybridization, glaciation and geographical parthenogenesis. *Trends in Ecology & Evolution* 20:495–502.

Peters, V.G. 1971. Die intragenerischen Gruppen und die Phylogese der Schmetterlingsagamen (Agamidae: *Leiolepis*). *Zoologische Jahrbücher der Systematik* 98:11–152.

Reeder, T.W., C.J. Cole, and H.C. Dessauer. 2002. Phylogenetic relationships of whiptail lizards of the genus *Cnemidophorus* (Squamata: Teiidae): A test of monophyly, reevaluation of karyotypic evolution, and review of hybrid origins. *American Museum Novitates* (3365):1–61.

Schmitz, A., M. Vences, S. Weitekus, T. Ziegler and W. Böhme. 2001. Recent maternal divergence of the parthenogenetic lizard *Leiolepis guentherpetersi* from *L. guttata*: Molecular evidence (Reptilia: Squamata: Agamidae). *Zoologische Abhandlungen, Staatliches Museum für Tierkunde in Dresden* 51:355–360.

Townsend, T.M., A. Larson, E. Louis, and R.J. Macey. 2004. Molecular phylogenetics of Squamata: The position of snakes, amphisbaenians, and dibamids, and the root of the squamate tree. *Systematic Biology* 53:735–757.

Wright, J.W. and C.H. Lowe. 1968. Weeds, polyploids, parthenogenesis, and the geographical and ecological distribution of all-female species of *Cnemidophorus*. *Copeia* 1968:128–138.





The big wildlife attraction on Guana is the Stout Iguana (*Cyclura pinguis*).

## The Herpetofauna of Guana Island: An Annotated Checklist and Travelogue

Gad Perry<sup>1</sup> and Robert Powell<sup>2</sup>

<sup>1</sup>Department of Natural Resource Management, Texas Tech University, Lubbock, Texas 79409, USA  
<sup>2</sup>Department of Biology, Avila University, Kansas City, Missouri 64145, USA

Guana Island is a remarkable place. A high-end working hotel much of the year ([www.guana.com](http://www.guana.com)), this privately-owned island in the British Virgin Islands (BVI) is also an informal wildlife sanctuary. Each year in October, it serves as the home base for scientists studying everything from plants to bats. During “science month,” Guana is the headquarters for scientific work that extends well beyond the island’s shores. What allows all of this to happen is the generosity of the owners, who have supported the research for many years and are committed to the continued protection of the island and its remarkably diverse plant and animal life. Biological work on



GOOGLE EARTH

Despite its relatively small size, Guana is a polyglot of varied elevations and habitats.



GAD PERRY

The dry tropical forest of Guana is home to several cacti, as well as trees and shrubs. The white stains on the rocks are guano from sea birds.



JOHN BINNS

Although ghuts (draws or arroyos) may be relatively humid, many of Guana’s slopes and ridges are quite dry and are characterized by succulents and other xeric-adapted species.

Guana was initiated in 1980 by Dr. James (“Skip”) Lazell, and remains under his direction today. Herpetology is a major focal point of the work, but the scope is extensive and includes studies of soils and topography, plants and fungi, invertebrates, and all vertebrate groups. Disciplines represented have been heavily ecological and conservation-oriented, but also include archeology, ethology, physiology, remote sampling, and a broad range of systematic studies.

We have been fortunate to conduct work on this unique island for some years now, and to observe the work of many others. In the realm of herpetology, this includes basic inventories, descriptions of new species, and detailed studies of ecology, ecophysiology, and ethology. Conservation, including the restoration of the highly endangered





JOHN BINNS

With the hotel restricted to a small area along a single ridge and other visitor-frequented areas largely limited to the beach and nearby recreational areas (tennis, croquet, etc.), the vast majority of Guana serves as a nature reserve. Tortola is visible in the distance.

Stout Iguana (*Cyclura pinguis*), is a major focus as well. Finally, the scientists involved engage in varied educational efforts for groups ranging from the younger members of the owners' family, through school-aged local kids, to students from the local community college and from Texas Tech University. In this article, we present a travelogue, focusing on the island as a destination, discuss herpetologically



ROBERT POWELL

A small flock of Greater Flamingos graces the mangrove-bordered salt pond on Guana.

oriented educational activities, and present an annotated checklist of its amphibian and reptilian species.

#### An Introduction to Guana Island

Purchased by the current owners in the 1970s, only a tiny portion of Guana is in any way developed. Most of the island is covered by tropical dry forest, a vegetation type that is more endangered but less often discussed than tropical rain forest. Also present are sandy and rocky beaches, a small patch of mangroves, and two types of ghut (the local name for arroyo) vegetation, one of which includes larger trees whereas the other contains a large number of native palms. Signs of the 18th-century Quaker habitation remain, primarily in the form of overgrown ruins readily exploited by today's reptiles; however, the Quakers engaged in very little cultivation and much of the island was untouched. Few Caribbean islands have been so effectively protected for so long. As a result, wildlife of all kinds abounds.

For paying guests, the small hotel offers a high-end experience focused on simplicity and nature. The rooms do not have air conditioning, large TVs blaring CNN, or constantly ringing phones. The number of guests is kept small, and no disco or casino disturbs the natural ambiance. On the other hand, the rooms are tasteful, the beds are very comfortable, the service is great, and the food is wonderful. Walking trails cover the island. The package that guests receive when they arrive includes a backpack, a diving mask, and a snorkel. They fall asleep to the sounds of the wind, the sea, and calling frogs. They



ROBERT POWELL

The ruins of an 18th-century Quaker sugar mill grace the shore of the salt pond.

wake up refreshed, and if they can't remember what day of the week it is, so what?

#### The Amphibians and Reptiles of Guana Island

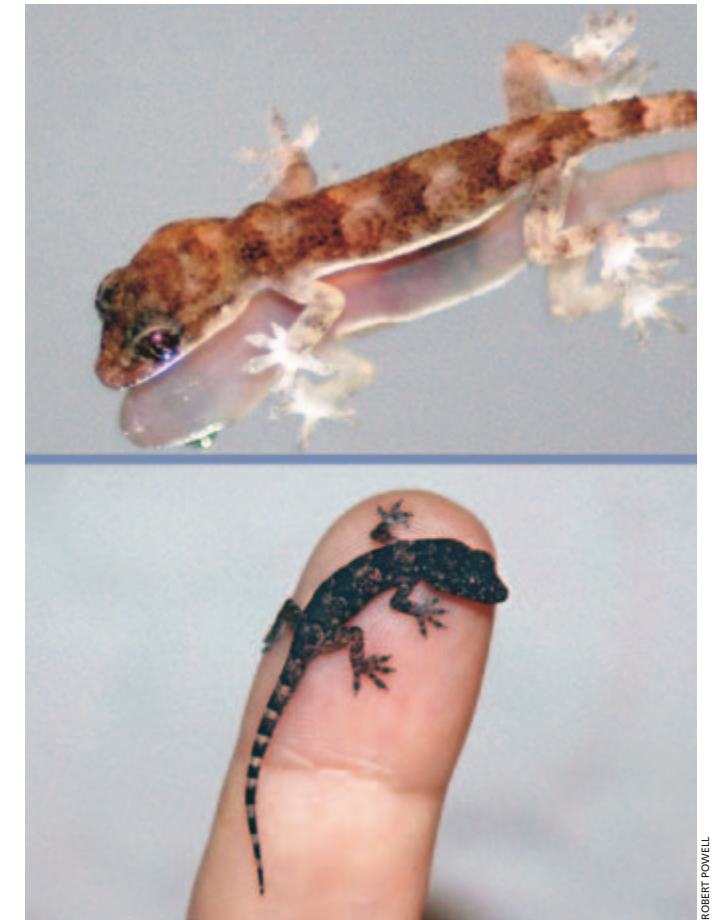
Only one species of frog resides on Guana, the Puerto Rican Rainfrog, *Eleutherodactylus antillensis*. It is small, active mostly at night, and likes humidity. The call sounds like "chew-weep, chew-weep," but males also have a clicking call that they use to warn competitors away. A single Cuban Treefrog (*Osteopilus septentrionalis*) — an invasive species that is rapidly spreading in the region — has been captured on the island, but the owners have been quite aggressive in checking arriving plants and construction materials to make sure that this indiscriminant predator does not become established. No other Cuban Treefrogs have been seen, even as the species continues to spread, affecting native frogs and lizards on other islands in the area.

The waters around Guana are a good place to look for, and often find, sea turtles, especially the endangered Hawksbill (*Eretmochelys imbricata*). Few nesting attempts have been documented on the island, but several other sea turtle species can be found in the waters of the BVI, including gigantic Leatherbacks (*Dermochelys coriacea*), locally known as "trunk." The origin of the Red-footed Tortoise (*Chelonoidis carbonaria*) is still being debated. They may have dispersed to this area naturally, or they may have been introduced by early human settlers. Either way, the species had been eradicated from many of the islands in the region, but was restored to Guana through

the work of Skip Lazell. Finding the tortoises is quite difficult; despite their relatively large size and colorful legs, they blend remarkably well with the dappled shade of the forest.

Another elusive resident is the Virgin Islands Worm Lizard (*Amphisbaena fenestrata*). When Lazell first came to the island, old-timers told him about an "earthworm with teeth." This eventually turned out to be a blind, burrowing lizard that does indeed resemble an earthworm. Like most other subterranean reptiles and amphibians, little is known about the biology of this species. They emerge after heavy rains, can be seen under rocks at some elevations at other times, and have very little resistance to water loss — but little else is known about them.

Two species of geckos occur on Guana. Puerto Rican Dwarf Geckos (*Sphaerodactylus macrolepis*) can be seen scurrying wherever leaf-litter and shade are abundant. Unlike most geckos, they are active during the day, on the ground, and lay a single egg instead of the customary two. Very small, these colorful creatures must protect themselves from excessive water loss and are most often seen during wet periods. Remarkable, despite their tiny weight — an individual weighing half a gram is a giant among sphaeros — the numbers of these lizards can be so high that their combined biomass exceeds that of wild game in the African savannah! Indeed, the Guana population was described as the world's densest terrestrial vertebrate a few years ago, with numbers in optimal habitat about 67,600 per hectare. The other species is the Cosmopolitan House Gecko (*Hemidactylus*



ROBERT POWELL

Cosmopolitan House Geckos (*Hemidactylus mabouia*) readily coexist with humans. These juveniles shared a room with one of the scientists, exploring the bathroom mirror at night.



*mabouia*), which resembles many other members of the genus in being nocturnal, climbing, and closely associated with humans. House Geckos are uncommon in the forest but can often be seen darting after insects on buildings at night. Most likely the species was introduced here hundreds of years ago, but the exact time of arrival

has not been established. The larger South American Turnip-tailed Gecko (*Thecadactylus rapicauda*) has never been seen on Guana, despite being common on some of the Virgin Islands.

The three anoles found on Guana are all abundant. The Crested Anole (*Anolis cristatellus*) has been the most studied, with efforts



ROBERT POWELL  
A



B

GAD PERRY



GAD PERRY  
C



D

GAD PERRY



ROBERT POWELL  
E



F

GAD PERRY

A: Locally known as the “Bo-peep” Frog, *Eleutherodactylus antillensis* is the only amphibian species on Guana. B: The team that inspected a barge full of ornamental plants bound for Guana to ensure that no Cuban Treefrogs hitched a ride. C: A young Red-footed Tortoise (*Chelonoidis carbonaria*) faces the world. Although historically present, tortoises had to be reintroduced onto Guana after disappearing for unknown reasons. D: An amphibaenian (*Amphisbaena fenestrata*) making a rare aboveground appearance. E: Diminutive Dwarf Geckos (*Sphaerodactylus macrolepis*) may have the greatest population density of any vertebrate in the moist Sea Grape leaf litter near the beaches on Guana. F: A shiny Slipperyback (*Mabuya sloanii*). These skinks are not uncommon, but are rarely captured because of the alacrity with which they hide in dense (often spiny) vegetation or rock crevices.

focusing on abundance, territorial size, foraging behavior, diet, movement patterns, water loss, and more. The species is common and apparent in many areas, including the hotel itself. Males of this species are territorial, displaying often and occasionally engaging in fights that can last for over 30 minutes and involve much posturing,

biting, and even knocking rivals off trees. Feeding primarily on invertebrates, Crested Anoles occasionally take small fruits. Anoles, in turn, are eaten by a number of the island’s residents, including birds (Kestrels, two species of cuckoos, Pearly-eyed Thrashers) and snakes. The smaller Saddled Anole (*A. stratulus*) is equally abundant in many



GAD PERRY  
A



B

GAD PERRY



ROBERT POWELL  
C

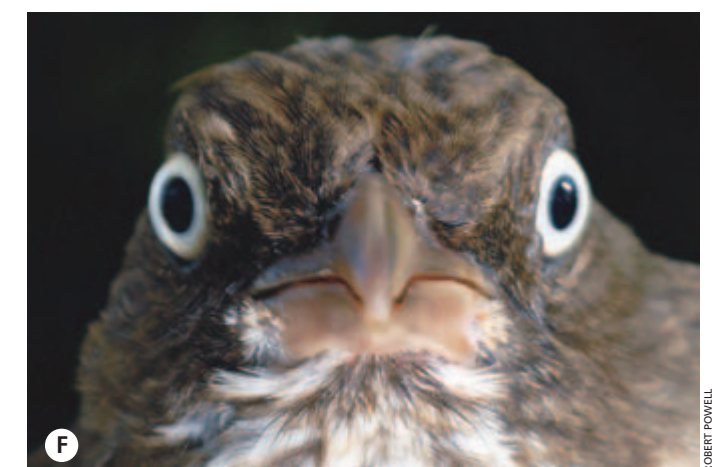


D

ROBERT POWELL



GAD PERRY  
E



F

ROBERT POWELL

A & B: Crested Anoles (*Anolis cristatellus*) happily coexist with humans. An adult male uses an old cannon as a display site and a female forages at a night-light during the dark hours. This tolerance of humans may explain the success with which this species has invaded several areas far beyond the Puerto Rico Bank. C: Adult male Puerto Rican Ground Lizards (*Ameiva exsul*) are encountered in patches of sunlight throughout the island. D: Ground lizards are sun-lovers and like it hot. When foraging in forested areas, they frequently pause in patches of sunlight to bask. E: No one had observed a ground lizard swimming before this photograph was taken of a young animal that jumped off a barge when chased, then swam back to safety. F: Aptly named Pearly-eyed Thrashers are aggressive predators of small lizards, birds, and insects, but also eat fruits.



places. Saddled Anoles often seem fearless, allowing people to approach very closely. On Puerto Rico, they often range very high into the crowns of trees, but on Guana, where trees are shorter, they



**A:** Lynford Cooper, Gad Perry, and James “Skip” Lazell (from left to right) insert an electronic tag in the tail of an adult Stout Iguana (*Cyclura pinguis*). **B:** Hatchling Stout Iguanas (*Cyclura pinguis*) are frequently seen on Guana during the hatching season in September and October. Hatchlings are captured, measured, injected with an electronic marker, numbered (this is No. 19), and released in order to gather data on growth, survival, and movements. **C:** Little is known about the biology of the burrowing blindsnake *Typhlops richardii*. Note the spiked tail tip, which is used as an anchor when burrowing and with which the snake will try to establish traction when handled. **D:** The Puerto Rican Groundsnake (*Arrhyton exiguum*), sometimes called the “Small Racer,” is most frequently encountered on Guana after dark, but other populations are known to be active by day. **E:** Some but not all Puerto Rican Racers (*Alsophis portoricensis*) respond to threats with a cobra-like display. **F:** Although apparently rare, cannibalism does occur in the Puerto Rican Racer. Here, the larger snake died after ingesting the smaller one.

are usually encountered at face level and even on the ground. The third anole on the island, the Puerto Rican Grass Anole (*A. pulchellus*) is both the most attractive and the hardest to see. Its elongated

form merges imperceptibly with the narrow stems on which it lives. Like other members of the genus, however, males have well-established territories that are fiercely defended from other males.

Three more species complete the lizard list. First is a skink known locally as the Slipperyback (*Mabuya sloanii*). Like many other skinks, its scales are smooth and shiny. This species is most often found in shady, rocky areas. They quickly scurry into the vegetation or a crevice, and little is known about their biology. Some evidence suggests that what appears to be a single species in the BVI is actually comprised of several similar, but genetically distinct forms. The Carrot Rock population was described as a separate species some years ago, and analyses of other populations are ongoing. The Puerto Rican Ground Lizard (*Ameiva exsul*) is very conspicuous on sunny days — striped juveniles roam the ground, pushing their pointy snouts into leaf litter or crevices in search of insects to eat, while the more colorful and much larger males search for bigger prey and females. A few years ago, we documented, for the first time, that these lizards can and will choose to swim; we observed several individuals leap off a barge into the sea to avoid capture, swim like Marine Iguanas, then climb back onto the boat.

The big attraction among lizards is, of course, the Stout Iguana (*Cyclura pinguis*). One of the most endangered species in the world, even the most optimistic population estimates do not exceed 500 individuals. Half that number may be more realistic, and about half of them live on Guana. At one point, these iguanas were found throughout the greater Puerto Rico Bank (Puerto Rico proper, its

satellite islands, and the U.S. and British Virgin Islands with the exception of St. Croix). Although even the experts disagree about the cause — some suggest that predation by humans and introduced predators is primarily responsible, whereas others implicate climatic changes — by the time 20th-century biologists arrived on the scene, the only iguanas still living were all on Anegada in the BVI. By the 1970s, their situation was becoming grim due to human persecution, predation by introduced cats, and competition from introduced ungulates. Hunters seeking food had long since extirpated flamingoes from Anegada, so, in the early 1980s, Dr. Lazell engineered a swap. In exchange for flamingoes, donated by the owners of Guana, eight iguanas were brought to Guana from Anegada. These began reproducing, and the Guana population has in the meantime both grown and become the seed for reestablishing the species on additional islands. Whenever it is sunny, iguanas are a common sight on Guana Island trails — especially after the juveniles emerge in September and October. Happily, the iguanas have been reintegrated into the local ecosystem and are eaten by both snakes and birds of prey.

Three snake species occur on Guana, but two of them are rarely encountered. One (*Typhlops richardii*) is a blind snake. Although quite common, it is rarely seen above ground, and its ecology is poorly understood. Another, the Small Racer (*Arrhyton exiguum*), is uncommon and secretive. On Guana, it is frequently seen at night, but the very small sample size — we normally see only one or two during our study season — means that we know relatively little about them. At the Sage Mountain Reserve on nearby Tortola, the highest



Dr. Barry Valentine, entomologist par-excellence, studying the day's catch. Above is part of his seasonal booty.



Dr. Kate LeVering holding the largest Racer ever caught on Guana. The kind of tail damage (inset) is common, but its cause remains unclear.





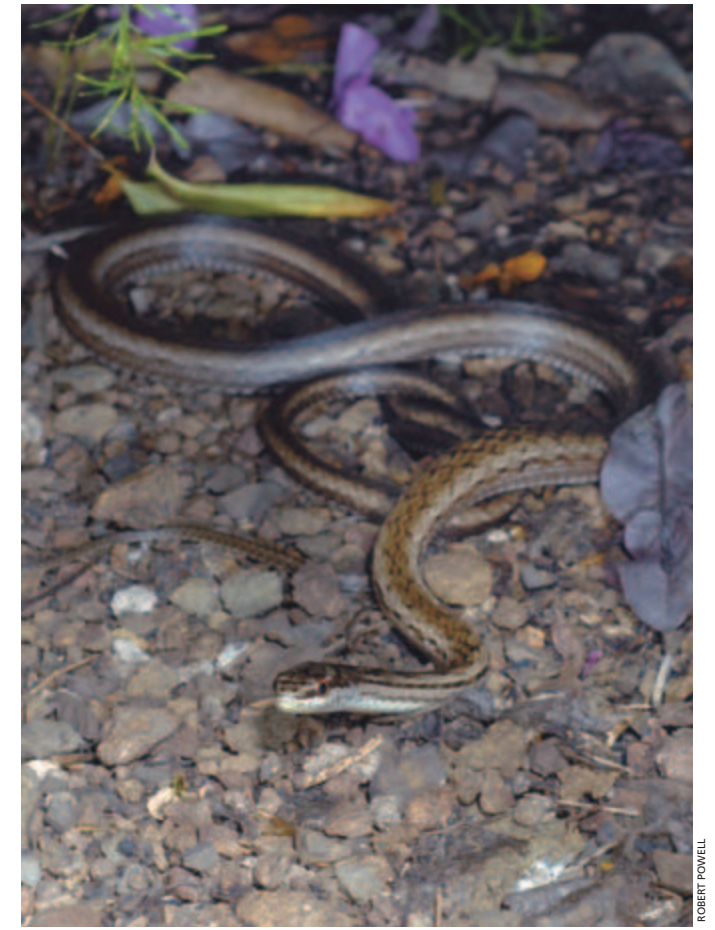
Male Saddled Anoles (*Anolis stratulus*) are fiercely territorial. Their dewlap displays add a splash of bright color to the dry forests of Guana.



Slender Puerto Rican Grass Anoles (*Anolis pulchellus*) often are hard to see among blades of grass.



Two male Crested Anoles (*Anolis cristatellus*) fighting over a territory centered on a date palm. This battle lasted over 30 minutes and ended with the slightly larger invader displacing the former resident.



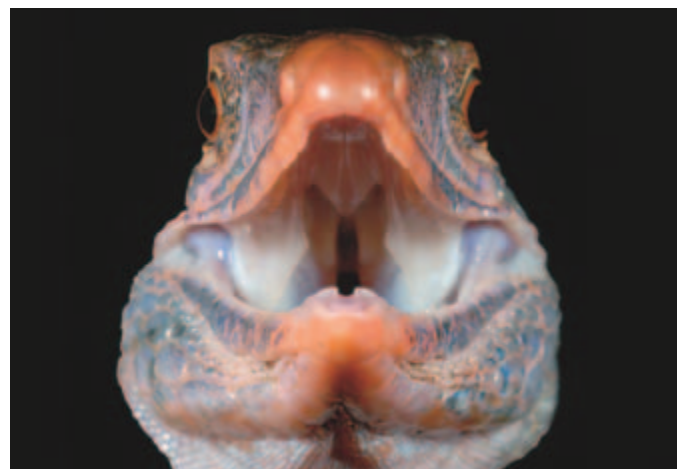
Puerto Rican Racers (*Alsophis portoricensis*) appear to exploit every habitat on Guana, including the hotel grounds — which illustrates the ability of humans and snakes to coexist when the latter are not persecuted.

and wettest spot in the Virgin Islands, this species is much more common and active during the day, suggesting that high rates of water loss may be a limiting factor on Guana.

The Puerto Rican Racer (*Alsophis portoricensis*) is abundant on Guana. On many islands in the region, the introduction of cats and especially mongooses has decimated the populations of ground-

dwelling snakes and lizards, but Guana has no mongooses. Consequently, anyone walking the trails of Guana with their eyes open is virtually guaranteed to encounter at least one of these animals. In the last few years, we have been part of a project that individually marked and measured some 500 individual animals, and we are a long way from having a complete inventory — low rates of recapture suggest that the population is in the thousands. These snakes are active throughout the day and seem to exploit every available habitat on Guana. Because of the high densities and intensive effort, we have been able to document previously unobserved behaviors such as swimming, cannibalism, and feeding on baby iguanas. We have noted that some individuals will flatten their necks in a cobra-like display when threatened, although we do not yet know how this helps the animals or why only some snakes do it. We also noted that virtually all adults are missing the tips of their tails, but are not yet sure what is responsible.

One final snake closes this list, the Virgin Islands Boa (*Epicrates monensis*). This endangered snake was reported from Guana many decades ago, but has not been seen since then despite repeated searches. Suitable habitat appears to be present, and we do not know if we simply have not yet found this nocturnal snake, whether the original record was erroneous, or if the species was once present on Guana but has since disappeared for an unknown reason. That the species is relatively common on nearby Tortola gives us hope that it may yet be found on Guana.



Adult Puerto Rican Ground Lizards (*Ameiva exsul*) have powerful jaws and can inflict a painful bite.

#### Herpetological Education on Guana Island

Research is important, but disseminating knowledge is just as crucial. One part of that mission is accomplished by articles such as this and by more technical publications in other journals. Another part, however, is educating people face-to-face. Over the years, participants in the Guana Island science month have done this in many ways. For the general public, scientists present their work on Guana and elsewhere at an annual symposium held at the H. Lavity Stoutt Community College on Tortola. This event attracts residents from throughout the BVI. Several local groups, ranging from boy scouts to college students, come to Guana each year and interact with the scientists. The hope is that a better-educated public is more inclined to support conservation action throughout the BVI, most of which remains poorly protected.

Another important educational effort centers on US-based students. Over the years, both undergraduates and graduate students have come to Guana. Undergraduate classes are typically diverse, combining lectures with hands-on experiences. Graduate classes are research-oriented, teaching not only about tropical ecology and conservation but also how to conduct group research and get it published in the peer-reviewed literature. Herpetological projects have focused on anoles, ground lizards, and dwarf geckos. In addition, individual students have been involved in projects on racers, iguanas, and Crested Anoles, and some of those studies have led to published articles.

The final group with which we work on a regular basis includes the children and grandchildren of the island's owners. As they will make the decisions about the management of the island in the future, we want them to learn to love it and its inhabitants. In 2008, we spent close to a week teaching them about herpetology, with Jennifer



The recent discovery of the Virgin Islands Boa (*Epicrates monensis*) on a nearby island lends credence to reports of the species on Guana, where it has not been seen since an unverified report many decades ago.





Joydeep Bhattacharjee talks about invasive Saltcedar trees at the annual symposium held at the H. Lavity Stoutt Community College on Tortola.



Dr. Matt Gifford talks to Pathfinders from Tortola about Guana's ground lizards.



The children meet a hatchling Stout Iguana marked #6.

Owen leading the program. The "boxes" on the facing page present some of their comments in their own words.

#### Acknowledgements

We are indebted to the owners of Guana Island for allowing us repeated access to this unique place. Support for this project was pro-



Mckenzie Jarecki gets to know a Puerto Rican Racer (*Alsophis portoricensis*).

vided by The Conservation Agency through a grant from the Falconwood Foundation, and by Texas Tech University. The Guana Island staff deserves special thanks not only for putting up with the strange requests of scientists all these years, but also for getting into the spirit of things and helping with the work. This is manuscript T-9-1160 of the College of Agricultural Sciences and Natural Resource Management, Texas Tech University.

#### References

The following reflect many of the studies conducted on Guana Island during "Science Month."

- Barun, A. and G. Perry. 2003. *Amphisbaena fenestrata* (Virgin Islands Amphisbaena). Predation. *Herpetological Review* 34:244.
- Barun, A., G. Perry, R.W. Henderson, and R. Powell. 2007. *Alsophis portoricensis anegadae* (Squamata: Colubridae): Morphometric characteristics, activity patterns, and habitat use. *Copeia* 2007:93-100.
- Dmi'el, R., G. Perry, and J. Lazell. 1997. Evaporative water loss in nine insular lizard populations of the *Anolis cristatellus* group in the British Virgin Islands. *Biotropica* 29:111-116.
- Lazell, J. 1991. The herpetofauna of Guana Island: Diversity, abundance, rarity, and conservation, pp. 28-33. In: J.A. Moreno (ed.), *Status y Distribución de los Reptiles y Anfíbios de la Región de Puerto Rico*. Publicación Científica Miscelánea No. 1. Departamento de Recursos Naturales de Puerto Rico, San Juan.
- Lazell, J. 1997. The Stout Iguana of the British Virgin Islands. *Iguana Times (Journal of the International Iguana Society)* 6:75-80.
- Lazell, J. 2002. Restoring vertebrate animals in the British Virgin Islands. *Ecological Restoration* 20:179-185.



Emily Chandler – age 8

This year on Guana Island, we worked with herpetologists to find out more on reptiles and amphibians. At first we all sat down and briefly discussed the different categories of animals in the world. Then we talked about the way scientists classify animals and played a few games to teach us which animals go in which categories.

We each designed our own pretend reptile on paper and shared it with everyone before we started learning about real reptiles. The biggest category of reptiles on Guana is snakes and lizards. We learned how to make our own nooses and went out catching lizards, such as anoles. Then we learned how to mark, measure, weigh, and inject a tag into the animal to help track its information in the future because we hope to catch it again. Then the scientists wrote down all their information, called data, in a book. If they catch the same animal again, they can learn about how much it has grown, how much it has eaten, if any predators have gotten to it, and how far it moved.

We divided into groups to study different animals. My group studied the Bo-Peep Frog (*Eleutherodactylus antillensis*). I got my information by interviewing a scientist who studies these frogs. I asked her where it lives, what the scientific name is, what it eats, what its predators are, what calls it makes, what it looks like, what it is attracted to, how long it lives, and what places it might be found in. She answered all these questions for me and from that we made a PowerPoint presentation of the information.



James Chandler – age 9

On Guana Island this year, we studied herpetology, which is the study of reptiles and amphibians. The scientists introduced us to all of the different classes of animals, and we reviewed how animals are classified, which we had learned the year before. Then we started to zero in on reptiles and amphibians. We studied the different groups of reptiles first, which are turtles & tortoises, crocodilians, snakes & lizards, and the last living species, called the Tuatara, from an extinct group.

While we were doing this, the scientist split us into groups for our separate projects to come later. Mine was the Rock Iguana (*Cyclura pinguis*).

Some of the things we learned were how to tag and mark lizards and snakes and how they are tracked with radio transmitters. We were also lucky enough to watch the life and (natural) death of a snake and all the things scientists do to it, such as marking, weighing, measuring, recording the information, and setting it free in hopes of capturing it again later. In the case of the one that died, we were able to watch it being preserved and prepared for shipment to a museum. We discussed the idea of scientific ethics and trying not to hurt animals.

Then we got to work on our own projects. My group got our information by interviewing the scientists who study the Rock Iguana in real life. The Rock Iguana is endangered and is only found in the Caribbean. There are about 300 left on Guana Island, about 150 on Anegada, and about 100 on Necker Island. We learned about its habitat, what it eats, and what eats it (predators). Together we made a PowerPoint presentation explaining our information.

- Lazell, J. 2005. *Island: Fact and Theory in Nature*. University of California Press, Berkeley and Los Angeles.
- Lazell, J. and G. Perry. 1997. *Anolis cristatellus wileyae* (Virgin Islands Crested Anole). Frugivory. *Herpetological Review* 28:150.



Diana Chandler – age 12

This year over the course of five days, I worked on a project with a herpetologist and our main topic was male Crested Anoles. We studied the size of the anole's territory by looking at their movement patterns. To get the data, we learned to catch the anoles with nooses and mark them with nail polish on the back so they

could be identified when we caught them again. We then took measurements of the tail, body, and head, weighed them, and recorded all our information. Then, we had to put them back right where we found them so that we could see how far they had moved when we (hopefully) caught them again. We caught approximately 30 anoles, including recaptures, in all. The conclusion that we drew was that male Crested Anoles can expand their territory in one day up to 40 feet, though sometimes their territory remains a single tree. Also, even the ones that traveled tended to prefer remaining in trees.

- LeVering, K. and G. Perry. 2003. *Cyclura pinguis* (Stout Iguana, Anegada Rock Iguana). Juvenile predation. *Herpetological Review* 34:367-368.
- Nicholson, K.L., S.M. Torrence, D.M. Ghioca, J. Bhattacharjee, A.E. Andrei, J. Owen, N.J.A. Radke, and G. Perry. 2005. The influence of temperature and humidity on activity patterns of the lizards *Anolis stratulus* and *Ameiva exsul* in the British Virgin Islands. *Caribbean Journal of Science* 41:870-873.
- Owen, J. and G. Perry. 2005. *Anolis cristatellus wileyae* (Virgin Islands Crested Anole). Saurophagy. *Herpetological Review* 36:444.
- Owen, J., G. Perry, J. Lazell, C. Petrovic, and J. Egelhoff. 2006. *Osteopilus septentrionalis* (Cuban Tree Frog). Colonization of the British Virgin Islands. *Herpetological Review* 37:74-75.
- Perry, G., R. Dmi'el, and J. Lazell. 1999. Evaporative water loss in insular populations of the *Anolis cristatellus* group (Reptilia: Sauria) in the British Virgin Islands II: The effects of drought. *Biotropica* 31:337-343.
- Perry, G., R. Dmi'el and J. Lazell. 2000. Evaporative water loss in insular populations of *Anolis cristatellus* (Reptilia: Sauria) in the British Virgin Islands III: A common garden experiment. *Biotropica* 32:722-728.
- Perry, G., R. Dmi'el, and J. Lazell. 2004. *Amphisbaena fenestrata* (Virgin Islands Worm Lizard). Evaporative water loss. *Herpetological Review* 35:165-166.
- Perry, G. and G.P. Gerber. 2006. Conservation of amphibians and reptiles in the British Virgin Islands: Status and patterns. *Applied Herpetology* 3:237-256.
- Perry, G. and J. Lazell. 1997. *Anolis stratulus* (Saddled Anole). Nectivory. *Herpetological Review* 28:150-151.
- Perry, G. and J. Lazell. 2000. *Liophis portoricensis anegadae*. Night-light niche. *Herpetological Review* 31:247.
- Perry, G. and J. Lazell. 2006. *Anolis pulchellus* (Grass Anole). Nectivory. *Herpetological Review* 37:218-218.
- Perry, G., J. Lazell, K. LeVering, and N. Mitchell. 2007. Body size and timing of reproduction in the highly endangered Stout Iguana, *Cyclura pinguis*, in the British Virgin Islands. *Caribbean Journal of Science* 43:155-159.
- Perry, G., K. LeVering, A. Barun, and J. Lazell. 2007. *Alsophis portoricensis anegadae*. Scavenging. *Herpetological Review* 38:203.
- Perry, G., K. LeVering, I. Girard, and T. Garland, Jr. 2004. Locomotor performance and social dominance in male *Anolis cristatellus*. *Animal Behaviour* 67:37-47.
- Perry, G., K. LeVering, and N. Mitchell. 2003. *Cyclura pinguis* (Stout Iguana, Anegada Rock Iguana). Juvenile agonistic behaviors. *Herpetological Review* 34:367.
- Perry, G. and R. Powell. 2008. *Alsophis portoricensis anegadae* (Racer). Cannibalism. *Herpetological Review* 39:465.
- Perry, G., R. Powell, and H. Watson. 2006. Keeping invasive species off Guana Island, British Virgin Islands. *Iguana* 13:272-277.
- Powell, R. 2006. Lizard warfare. *Iguana* 13:22-23.
- Powell, R., G. Perry, R.W. Henderson, and A. Barun. 2006. *Alsophis portoricensis anegadae*. Aquatic activity. *Herpetological Review* 37:228-229.
- Rodda, G.H., G. Perry, R.J. Rondeau, and J. Lazell. 2001. The densest terrestrial vertebrate. *Journal of Tropical Ecology* 17:331-338.





Hellbender (*Cryptobranchus alleganiensis*) populations are in decline.

## Saving a Giant Salamander

Alicia Mathis and Adam Crane

Department of Biology, Missouri State University, Springfield, Missouri 65897

The largest salamander in North America is in decline (Wheeler et al. 2003). Hellbenders (*Cryptobranchus alleganiensis*) are the only representative of the family Cryptobranchidae that occurs outside of Asia, and are second in size only to their fellow cryptobranchids, the Asian Giant Salamanders (genus *Andrias*). In addition to being large, these salamanders are unusual in that they inhabit rivers where they co-exist with numerous fish species. Hellbenders have strict habitat requirements, including cool, fast-flowing waters with rocky substrates. Individuals are cryptic, with a mottled gray/brown coloration, and are dorsoventrally flattened to fit under large rocks (Petranka 1998). Because they depend heavily on cutaneous respiration, their bodies are covered with wrinkled skin that maximizes the surface area for gas absorption. Juveniles remain as

gilled larvae for 2–3 years and do not reach sexual maturity for 5–6 years (see Nickerson and Mays 1973 for an overview).

Because of their unusual appearance and life history, Hellbenders have received considerable attention from researchers, including intensive monitoring of some populations during the last half century. Two apparently paraphyletic subspecies of the Hellbender are currently recognized (Sabatino and Routman 2008). The eastern subspecies (*C. a. alleganiensis*) is distributed throughout the Appalachian region, reaching as far west as Missouri, and the Ozark subspecies (*C. a. bishopi*) is only found in a relatively small area of southern Missouri and northern Arkansas (Petranka 1998). In some eastern regions, Hellbender populations appear relatively healthy (Humphries and Pauley 2005, Nickerson et al. 2002), whereas declines in other populations, especially in the western portion of the species' range, have been quite large. In five Missouri streams, Hellbender population sizes have declined by over 75% since the 1970s (Wheeler et al. 2003). These sharp declines are characterized by age distributions that reveal a disproportionate decrease in numbers of smaller (younger) individuals. The Spring River in Arkansas once was home to robust numbers of Ozark Hellbenders (370 individuals marked in one study; Peterson 1985), but an intensive survey in 1991 yielded only 20 individuals. The Eastern Hellbender is now considered to be state-endangered throughout much of its range. Because all populations in the narrow range of the Ozark Hellbender are experiencing declines, this subspecies is currently a candidate for federal listing as endangered.

As is the case for many threatened species, the cause of population declines for Hellbenders is not known. However, detailed lists of possible contributing factors have been compiled (Mayasich et al. 2003; IUCN/SSC 2006). These factors include biological threats (disease and competition/predation by exotic species), overcollection for research, teaching, or commercial use, water quality issues (silt-



Hellbenders occupy cold, fast-flowing streams with high concentrations of dissolved oxygen.



Lateral skin folds help Hellbenders respire by increasing the surface area for gas exchange through the skin.





ADAM CRANE

The diet of Hellbenders consists primarily of crayfish.

tion, impoundments, agricultural runoff, runoff from urban/rural development, waste products from humans), and climate change. Progress is being made in investigating some of these issues.

#### Disease

One pathogenic fungus, *Batrachochytrium dendrobatidis* or 'chytrid,' is known to be responsible for amphibian declines throughout the world (e.g., Skerratt et al. 2007). Recently, the chytrid fungus has been found on Hellbenders in five different rivers in Missouri and Arkansas (Briggler et al. 2008), and up to 25% of Hellbenders that have been tested from populations in Missouri have tested positive (Briggler 2007). The symptoms of chytrid infection (Berger et al. 1998) are similar to the health problems (see below) found in some Hellbenders, but so far the number of infected adults has not been adequate to look for a correlation between chytrid infections and these problems (J. Briggler, pers. comm.). Regardless, at the very least, the chytrid fungus probably works as a stressor to exacerbate problems from other sources (J. Briggler, pers. comm.).

#### Physical Abnormalities

A particularly alarming finding in declining populations is that many of the remaining Hellbenders have mild-to-severe physical abnormalities. Interpretation of these problems is complicated because Hellbenders are aggressive during the breeding season, and wounds from bites from other Hellbenders are common at those times

(Humphries and Pauley 2005, Miller and Miller 2005). However, researchers who have studied these populations for many years have concluded that the number and severity of abnormalities have increased dramatically over the last few decades (Hiler et al. 2005; M. Nickerson, R. Wilkinson, S. Trauth, pers. comm.). Physical abnormalities were exhibited by 41% of adults (and no juveniles) in Tennessee and by 25% of individuals in Ohio. In Arkansas and



SHEM UNGER

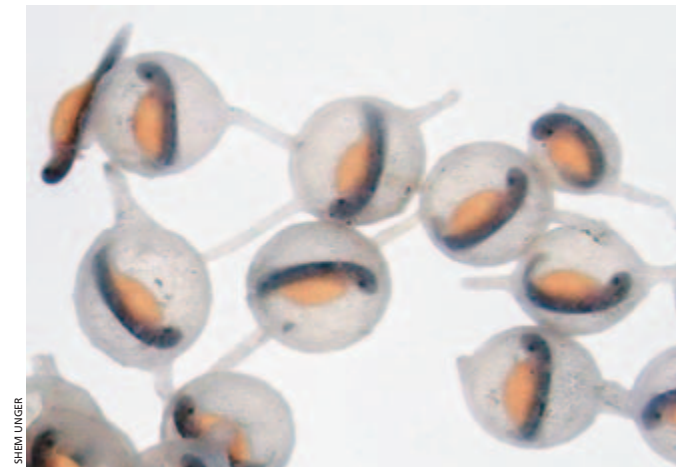
Abnormal digit sores found on a wild-caught adult Hellbender.

Missouri, the number of abnormalities varies among populations. Hiler et al. (2005) reported that 90% of the small remaining population of Ozark Hellbenders in the Spring River and 40% in the Eleven Point River in Arkansas exhibited abnormalities, and Briggler (2007) stated that abnormalities were more common for the Ozark subspecies than the eastern subspecies in Missouri. In addition to bite marks from other Hellbenders, Hiler et al. (2005) categorized the abnormalities as tumors, open wounds, fungal infections, necrotic limbs, missing limbs, digital abnormalities, eye abnormalities, and cloacal wounds. The causes of the dramatic increases in abnormalities are not yet known.

#### Predation by Exotic Species (Trout)

One hypothesis for the current low recruitment observed in some Hellbender populations is increased predation on larvae and/or eggs. Hellbenders are likely subject to predation from a variety of predators, including native fishes (e.g., bass, sculpin, walleye), but without evidence of growth in the abundance of these species, increased predation by native species seems unlikely. The most likely candidate for increased predation by a non-native predator is trout. Both Rainbow (*Oncorhynchus mykiss*) and Brown (*Salmo trutta*) trout have been introduced at high rates into many streams containing both declining (Alsup 2005) and relatively healthy (USFWS 2001) populations. Although trout have been stocked in Missouri since the late 1800s, the numbers of trout in Missouri streams has increased by approximately three-fold since the 1960s (Alsup 2005). Each year, about one million trout are stocked in several trout parks and management areas in Missouri streams, and over half of these sites are on streams historically occupied by Hellbenders (Alsup 2005). If trout are predators of Hellbenders, this high rate of introduction could potentially have a negative impact on Hellbender population sizes.

With respect to trout, one difference between eastern and western populations of Hellbenders is that many of the eastern streams also are home to a native salmonid, the Brook Trout (*Salvelinus fontinalis*), whereas streams in Missouri have no native trout. In 2002, we were fortunate to collect clutches of eggs from a population in North Carolina (which co-occurs with the native Brook Trout) and from populations of Ozark and Eastern Hellbenders in Missouri for use in another study (Unger 2003; one clutch per population). After rearing larvae in captivity for approximately six months, we tested to see



SHEM UNGER

Hellbender embryos are nourished by the yolk inside their eggs.



ADAM CRANE

A six-month-old larva uses its large external gills for respiration.

whether they would perform fright behavior (reduced activity) to the scent of Brown Trout. The populations differed in their responses to the trout stimuli, with larvae from the North Carolina population showing stronger fright responses than larvae from the declining Missouri populations (average fright scores: NC = 210, MO-Ozark = -50, MO-eastern = 90; ANOVA,  $P < 0.05$ ). The populations did not differ with respect to responses to a control stimulus from non-predatory fish (Stonerollers, *Campostoma anomalum*; NC = 10, MO-Ozark = 90, MO-eastern = -20;  $P > 0.05$ ). These results suggest that introduced trout may present more of a problem to larval Hellbenders from declining populations in Missouri (where there are no native trout) than to the more stable population in North Carolina. Note, however, that these data should be interpreted with caution because only one clutch was tested from each population.

Do larvae from declining populations show reduced responses to predators in general or is the reduced response specific to introduced predators? Recent laboratory studies by Gall (2008) extended the above study by examining fright responses to native and non-native fishes by larvae from multiple clutches of eggs gathered from the declining Missouri populations. The data revealed that Hellbender larvae may be especially vulnerable to trout; as in the preliminary study, larvae exhibited relatively low levels of fright (reduced activity) when exposed to trout chemical cues. In contrast, larvae reacted with stronger antipredator behavior when exposed to cues from native fishes, indicating that they are capable of recognizing and responding to native predatory fishes.





Captive-reared Hellbenders in an aluminum raceway.

### Captive Breeding and Rearing

Because of the Hellbender's declining populations, the establishment of captive breeding and head-starting programs has been suggested (Mayasich et al. 2003). The Ron Goellner Center for Hellbender Conservation at the St. Louis Zoo has undertaken intensive captive breeding efforts ([www.stlzoo.org/wildcareinstitute/hellbendersinmissouri/](http://www.stlzoo.org/wildcareinstitute/hellbendersinmissouri/)); adult Hellbenders recently have deposited eggs in an artificial raceway, but so far none have been successfully fertilized either by captive males or through attempted artificial insemination (M. Wanner, pers. comm.). In addition to the captive breeding attempts, The Goellner Center also reared juveniles resulting from clutches collected from the wild by Unger (2003); these "head-started" juveniles were released and are currently being monitored by radio-telemetry (Briggler 2007). However, one concern upon release of captive-reared Hellbenders is that even large juveniles could still be quite vulnerable to predation by large trout. Some head-starting programs for other aquatic species have done a pre-release predator training to help increase survival in the wild (e.g., salmon: Berejikian et al. 1999; trout: Mirza and Chivers 2000). Because of Gall's (2008) findings that larvae did not exhibit high levels of fright to trout, we recently attempted to train larvae to fear trout. Using a methodology that could be implemented in future head-starting programs for Hellbenders, we demonstrated that larvae can learn to associate higher levels of danger with chemical cues from trout (Crane and Mathis, unpubl. data).

### Declining Reproduction?

Low recruitment in declining populations also could be explained by decreased reproduction. Unger (2003) investigated reproduction by males in declining and healthy populations. In the first year of the study, only two males in his samples from the declining (Missouri) populations produced any milt, and both semen samples were clumpy with no apparent sperm motility. In the second year, samples were more normal in appearance, but males from declining populations had significantly lower sperm counts than Hellbenders from more stable populations in Georgia and North Carolina (Unger 2003). One hypothesis for the cause of these reproductive problems is poor water quality. Because Hellbenders are fully aquatic and respire almost entirely through their skin (Guimond and Hutchison 1973), they easily can be affected by stream inputs from pesticides, herbicides, agriculture, and erosion. Additionally, Hellbenders are long-lived (30+ years) and pollutants likely accumulate and remain in their tissues for many years (Stebbins and Cohen 1995). In Unger's (2003) study, Hellbenders from Georgia and North Carolina occupied streams in national forests, whereas the Hellbender sites in Missouri are surrounded predominantly by land used for agriculture. Although the nutrient concentrations in Missouri streams likely have not changed much in the past 20–30 years, Hellbenders in Missouri streams are exposed to a variety of organic chemicals that could negatively affect reproduction (Solis et al. 2007). These chemicals (industrial chemicals, plant sterols, and herbicides) at higher levels have been found to have estrogenic effects in shorter-lived amphibians (Mackenzie et al. 2003, Lee et al. 2005). When these chemicals became prevalent in Missouri streams and what species-specific effects they have on Hellbenders is unknown (Solis et al. 2007).

The outlook for the Ozark Hellbender and some populations of the Eastern Hellbender continues to look bleak, but the good news is that progress in conservation efforts is being made. These efforts are being spearheaded by individuals who contribute a wide range of expertise to the problem, including academic researchers, state and federal government biologists, zoo biologists, and conservation education specialists. Captive-rearing and breeding efforts may be our best chance to save the declining Hellbender populations, and efforts by researchers to better understand the plethora of causes responsible for the decline will hopefully enable us to protect the remaining healthy populations from the same threats.



The activity of Hellbenders exposed to different treatments is monitored in the lab.



A wild-caught Hellbender measured in the field.



Hellbender sperm collected from an adult in a healthy population.

### Acknowledgements

Some of the research projects described herein were supported by the Missouri Department of Conservation, the U.S. Fish and Wildlife Service, and Missouri State University. We greatly appreciate the insights of MDC's Jeff Briggler and salute him for his dedication to the conservation of Hellbenders in Missouri. The work of Brian Gall and Shem Unger in our laboratory at Missouri State made great contributions to our understanding of the state of the Hellbender in Missouri. We recognize the Ron Goellner Center for Hellbender Conservation at the St. Louis Zoo and James Civiello and the staff of the Shepherd of the Hills Hatchery for providing us with facilities for some of this work. Alexis Denny, Josh Braun, and Shem Unger conducted preliminary laboratory observations on larval Hellbender responses to trout.

### Literature Cited

- Alsop, K.D. 2005. An investigation of the potential threats of nonnative trout on Eastern (*Cryptobranchus alleganiensis alleganiensis*) and Ozark (*Cryptobranchus alleganiensis bishopi*) Hellbender decline. Unpublished M.S. thesis, Saint Louis University, Missouri.
- Berejikian, B.A., R.J.F. Smith, E.P. Tezak, S.L. Schroder, and C.M. Knudsen. 1999. Chemical alarm signals and complex hatchery rearing habitats affect anti-predator behavior and survival of Chinook Salmon (*Oncorhynchus tshawytscha*) juveniles. *Canadian Journal of Fisheries and Aquatic Sciences* 56:830–838.
- Berger, L., R. Speare, P. Daszak, D.E. Green, A.A. Cunningham, C.L. Goggin, R. Slocumbe, M.A. Ragan, A.D. Hyatt, K.R. McDonald, H.B. Hines, K.R. Lips, G. Marantelli, and H. Parkes. 1998. Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. *Proceedings of the National Academy of Science, USA* 95:9031–9036.

- Briggler, J. 2007. MDC Resource Science. Science Notes. Hellbender Recovery Actions in Missouri. Missouri Department of Conservation (MDC). Volume 2(15).
- Briggler, J., K.A. Larson, and K.J. Irwin. 2008. Presence of the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) on Hellbenders (*Cryptobranchus alleganiensis*) in the Ozark highlands. *Herpetological Review* 39:443–444.
- Gall, B. 2008. Predator-prey interactions between Hellbenders (*Cryptobranchus alleganiensis alleganiensis* and *C. a. bishopi*) and native and nonnative fishes. Unpublished M.S. Thesis, Missouri State University, Springfield, Missouri.
- Guimond, R.W. and V.H. Hutchison. 1973. Aquatic respiration: An unusual strategy in the Hellbender *Cryptobranchus alleganiensis alleganiensis* (Daudin). *Science* 182:1263–1265.
- Hiler, W.R., B.A. Wheeler, and S.E. Trauth. 2005. Abnormalities in the Ozark Hellbender (*Cryptobranchus alleganiensis bishopi*) in Arkansas: A comparison between two rivers with a historical perspective. *Journal of the Arkansas Academy of Science* 59:88–94.
- Humphries, W.J. and T.K. Pauley. 2005. Life history of the Hellbender, *Cryptobranchus alleganiensis*, in a West Virginia stream. *American Midland Naturalist* 154:135–142.
- IUCN/SSC Conservation Breeding Specialist Group. 2006. Hellbender population and habitat viability assessment. Apple Valley, Minnesota.
- Lee, S.K. and N.D.R. Veeramachaneni. 2005. Subchronic exposure to low concentrations of di-n-butyl phthalate disrupts spermatogenesis in *Xenopus laevis* frogs. *Toxicological Science* 84:394–407.
- Mackenzie, C.A., M. Berrill, C. Metcalfe, and B.D. Pauli. 2003. Gonadal differentiation in frogs exposed to estrogenic and antiestrogenic compounds. *Environmental Toxicology and Chemistry* 22:2466–2475.
- Mayasich, J., D. Grandmaison, and C. Phillips. 2003. Eastern Hellbender status assessment report. Final report, U.S. Fish and Wildlife Service, Region 3. Fort Snelling, Minnesota.
- Miller, B.T., and J.L. Miller. 2005. Prevalence of physical abnormalities in Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*) populations of middle Tennessee. *Southeastern Naturalist* 4:513–520.
- Mirza, R.S. and D.P. Chivers. 2000. Predator-recognition training enhances survival of Brook Trout: Evidence from laboratory and field enclosures. *Canadian Journal of Zoology* 78:2198–2208.
- Nickerson, M.A., K.L. Krysko, and R.D. Owen. 2002. Ecological status of the Hellbender (*Cryptobranchus alleganiensis*) and the Mudpuppy (*Necturus maculosus*) salamanders in the Great Smoky Mountains National Park. *Journal of the North Carolina Academy of Science* 118:27–34.
- Nickerson, M.A. and C.E. Mays. 1973. The Hellbenders: North American Giant Salamanders. *Milwaukee Public Museum Publications in Biology and Geology* 1:1–106.
- Peterson, C.L. 1985. Comparative demography of four populations of the Hellbender, *Cryptobranchus alleganiensis*, in the Ozarks. Unpublished Ph.D. Dissertation, University of Missouri, Columbia.
- Petranka, J.W. 1998. *Salamanders of the United States and Canada*. Smithsonian Institution Press, Washington, D.C.
- Sabatino, S.J. and E.J. Routman. 2008. Phylogeography and conservation genetics of the Hellbender salamander (*Cryptobranchus alleganiensis*). *Conservation Genetics* 10.1007/s10592-008-9655-5.
- Skerratt, L., L. Berger, R. Speare, S. Cashins, K. McDonald, A. Phillott, H. Hines, and N. Kenyon. 2007. Spread of chytridiomycosis has caused the rapid global decline and extinction of frogs. *EcoHealth* 4:125–134.
- Solis, M.E., C.C. Liu, P. Nam, D.K. Niyogi, J.M. Bandeff, and Y.W. Huang. 2007. Occurrence of organic chemicals in two rivers inhabited by Ozark Hellbenders (*Cryptobranchus alleganiensis bishopi*). *Archives of Environmental Contamination and Toxicology* 53:426–434.
- Stebbins, R.C. and N.W. Cohen. 1995. *A Natural History of Amphibians*. Princeton University Press, Princeton, New Jersey.
- Unger, S. 2003. Sperm production and larval development in Hellbenders (*Cryptobranchus alleganiensis alleganiensis* and *C. A. Bishopi*): A comparison of declining and stable populations. Unpublished M.S. Thesis, Southwest Missouri State University, Springfield, Missouri.
- U.S. Fish & Wildlife Service, Southeast Region. 2001. Economic effects of trout production by national fish hatcheries in the Southeast. U.S. Fish and Wildlife Service, Atlanta, Georgia.
- Wheeler, B.A., E. Prosen, A. Mathis, and R.F. Wilkinson. 2003. Population declines of a long-lived salamander: A 20+ year study of Hellbenders, *Cryptobranchus alleganiensis*. *Biological Conservation* 109:151–156.





*Abronia fimbriata* is one of the gems that live in the last forest remnants of Guatemala's highlands.

## Arboreal Alligator Lizards in the Genus *Abronia*: Emeralds from the Cloud Forests of Guatemala

Daniel Ariano-Sánchez<sup>1,3</sup> and Lester Melendez<sup>2,3</sup>

<sup>1</sup>Departamento de Biología, Universidad del Valle de Guatemala (darianosanchez@gmail.com)

<sup>2</sup>Curador de Reptiles, Museo de Historia Natural "Jorge Ibarra" (lestermelendez@yahoo.com)

<sup>3</sup>Research and Conservation Projects, Zootropic.

Guatemala is one of the world's biodiversity hot spots, attributable in part to its complex topography but also to its privileged location between two biotic realms, the Nearctic and the Neotropical (Campbell and Vannini 1989). The cloud forests of this small Central American country host an array of endemic birds, mammals, snakes, lizards, and amphibians. Virtually every mountain complex in Guatemala has at least one endemic species of reptile or amphibian (Acevedo 2006). Eighteen endemic species of reptiles and amphibians occur in the central volcanic chain of Guatemala, a count exceeded only by that of the Sierra de las Minas Mountains, which supports at least 24 endemic species. These mountains are located in the northern portion of the semiarid region of the Motagua Valley. The Sierra de las Minas casts a rain shadow across the valley, producing seasonally dry tropical forest in the valley and humid cloud forests near the peaks. This unique system harbors many exotic creatures found nowhere else on earth.

Among these unusual creatures are the Arboreal Alligator Lizards in the genus *Abronia*, known to locals as "dragoncitos" (tiny dragons). These secretive lizards live in the pine-oak and cloud forests of northern Mesoamerica and belong to the family Anguillidae (Campbell and Brodie 1999). Anguillid lizards appear to have had a northern origin in the supercontinent of Laurasia after the split of Pangaea (Macey et al. 1999).



Shortly after birth, juvenile *Abronia vasconcelosii* demonstrate agility and climbing ability.



*Abronia* spend most of their lives among the epiphytes of the cloud forests.

Species of *Abronia* occur from southern Tamaulipas and Guerrero, Mexico, to southern Honduras (Campbell and Frost 1993). In Guatemala, this group has diversified into 10 species, eight of them endemic. These national endemics are *A. anzuetoi*, *A. aurita*, *A. campbelli*, *A. fimbriata*, *A. frosti*, *A. gaiophantasma*, *A. meledona*, and *A. vasconcelosii*. Two other species are shared with southern Mexico, *A. matudai* and *A. ochoterani* (Acevedo 2006). With few exceptions, species of *Abronia* are known only from a limited number of specimens, often from only the type or a few specimens from the immediate vicinity of the type locality (Campbell and Frost 1993).

*Abronia* spend most of their lives among the epiphytes of the cloud forests and are strictly diurnal (Campbell and Frost 1993). Their prehensile tails are particularly useful adaptations to an arbo-





LESTER MELENDEZ

The long prehensile tail of this female *Abronia vasconcelosii* is a particularly useful adaptation to an arboreal lifestyle.

real lifestyle. Many species of *Abronia* (e.g., *A. fimbriata*) become quite tame in captivity, but some, such as *A. vasconcelosii*, seem to become more aggressive, probably responding to the stress of confinement. These lizards are insectivorous and, in captivity, feed voraciously on orthopterans. Predators are almost unknown, but snakes and birds presumably feed on these lizards. One of the most striking observations of predation was that of a magnificent Resplendent Quetzal (*Pharomachrus mocinno*) preying on an *Abronia* (probably *A. fimbriata*; Yee, pers. obs.; see the back cover of this issue).

All species of *Abronia* for which reproductive data are available bear live young (Campbell and Frost 1993). Captive breeding of *A. vasconcelosii* has been achieved in Guatemala by one of the authors (L. Melendez) at the Museo de Historia Natural "Jorge Ibarra." Six live young were born on 28 March 2008; however, none of them survived beyond nine months. This is the only known instance of *Abronia* reproduction within the country. Copulation of the reproductive pair occurred in late July, and the female was gravid for eight months.

Behavior of *Abronia* is largely limited to anecdotal observations, and field research on these species is almost non-existent. The conservation status of most species is uncertain, but restricted distributions and habitats disturbed or destroyed by human development have left most species in the genus among the most endangered lizards in the world (Campbell and Frost 1999). Moreover, many species of *Abronia* are threatened with immediate extinction. In all likelihood, at least *A. campbelli* (Brodie and Savage 1993) and *A. frosti*



JOHN BIRNIS

*Abronia*, such as this female *A. vasconcelosii*, associate closely with epiphytes.



LESTER MELENDEZ

A pair of *Abronia vasconcelosii* mating in captivity.

(Campbell et al. 1998) have become extinct since their discovery (Campbell and Mendelson 1998).

*Abronia*, along with the arboreal pit vipers of the genus *Bothriechis*, are among the gems that live in the last forest remnants of Guatemala's highlands. These forests, along with the unique clusters of endemic species they harbor, are at high risk of disappearing altogether. Many of the species that inhabit these forests likely will become extinct before even being discovered by science. The only things that can be said about *Abronia* with absolute certainty are that we know almost nothing about their natural history and that their habitat is in urgent need of conservation measures.

#### Literature Cited

Acevedo, M. 2006. Anfibios y reptiles de Guatemala: Una breve síntesis con bibliografía, pp. 487–524. In: E. Cano (ed.), *Biodiversidad de Guatemala, Volume I*. Universidad del Valle de Guatemala.

Brodie, E. and J. Savage. 1993. A new species of *Abronia* (Squamata: Anguillidae) from a dry oak forest in eastern Guatemala. *Herpetologica* 49:420–427.

Campbell, J. and E. Brodie. 1999. A new species of *Abronia* (Squamata: Anguillidae) from southeastern highlands of Guatemala. *Herpetologica* 55:161–174.

Campbell, J. and D. Frost. 1993. Anguillid lizards of the genus *Abronia*: Revisionary notes, descriptions of four new species, a phylogenetic analysis, and key. *Bulletin of the American Museum of Natural History* 216:1–121.

Campbell, J. and J. Mendelson III. 1998. Documenting the amphibians and reptiles of Guatemala. *Mesoamericana* 3:21–23.

Campbell, J. and J. Vannini. 1989. The distribution of amphibians and reptiles in Guatemala and Belize. *Proceedings of the Western Foundation of Vertebrate Zoology* 4:1–21.

Campbell, J., M. Sasa, M. Acevedo, and J. Mendelson III. 1998. A new species of *Abronia* (Squamata: Anguillidae) from the high Cuchumatanes of Guatemala. *Herpetologica* 54:221–234.

Macey, J., J. Schulte II, A. Larson, B. Tuniyev, N. Orlov, and T. Papenfuss. 1999. Molecular phylogenetics, tRNA evolution, and historical biogeography in anguillid lizards and related taxonomic families. *Molecular Phylogenetics and Evolution* 12:250–272.



IRCF

**Notice:** The IRCF staff has been developing a new website that we hope to launch when this issue ships, or shortly thereafter. We encourage all our members to take time to visit the site, and share the link with friends and colleagues. [www.IRCF.org](http://www.IRCF.org)





A Crested Anole (*Anolis cristatellus*) eating a Puerto Rican Coastal Blindsnake (*Typhlops hypomethes*).

## Turning the Tables: Lizard Eats Snake

Alfredo D. Colón Archilla

San Juan, Puerto Rico

Photographs by the author.

On 11 March 2009, I noticed what I initially thought was a lizard eating a worm in my backyard in San Juan, Puerto Rico. The lizard was a Crested Anole (*Anolis cristatellus*) and the “worm” turned out to be a Puerto Rican Coastal Blindsnake (*Typhlops hypomethes*) at least as long as the anole. When I disturbed the lizard, it quickly moved away, but never released what would be a very large, high-energy meal.

Many West Indian snakes, including racers (Dipsadidae) and boas (Boidae), feed primarily on lizards, although Blindsnakes in the

genus *Typhlops* are burrowers that feed almost exclusively on small arthropods (e.g., ants, termites, beetles). Nevertheless, one has to appreciate the irony of a lizard “turning the tables” and eating a snake.

### Acknowledgments

Fr. Alejandro J. Sánchez Muñoz alerted me to the significance of this unusual predation event. Richard Thomas confirmed the identity of the snake.



The presence of excrement under the snake's tail, which is released as an alarm or defensive behavior, indicates that the snake was alive when the anole captured (rather than scavenged) it.





Critically endangered Panamanian Golden Frogs (*Atelopus zeteki*) are thought to bring good luck and fertility.

## CONSERVATION ALERT

# Beyond 2008 “Year of the Frog”: The Challenges Facing Amphibians and the Amphibian Ark

Ron Gagliardo

AmphibianArk.org

### The Global Amphibian Crisis

As stated in no uncertain terms in many recent publications, television documentaries, and internet sources, amphibians are in serious trouble. The potential consequences of this unprecedented loss of biodiversity occurring in our lifetimes cannot be emphasized enough. The statistics speak for themselves: (1) Over one third of the 6,000 extant amphibian species are threatened and over one half are experiencing population declines; (2) This figure represents more endangered amphibians (frogs, salamanders, and caecilians) than birds, fishes, or mammals, making them the most threatened class of vertebrates on the planet; and (3) In the past few decades, over 122

species have been declared extinct in the wild, and all experts involved recognize this as a very conservative estimate.

Amphibian declines are not necessarily new. Based on information streaming in from many sources, changes in amphibian populations in different parts of the world have been documented since the 1980s. Monitoring the changes was difficult but, clearly, something was amiss. We needed a “head count.” In 2004, the International Union for the Conservation of Nature and Natural Resources (IUCN, 2008) compiled the first Global Amphibian Assessment, gathering data from scientists worldwide in an effort to develop an accurate picture of how amphibians were faring. The news was not



Despite the attention given to emerging infectious diseases, habitat loss is the leading threat to amphibian populations worldwide. Preserving pristine riparian habitats such as this stream in Panama is crucial to the future of amphibians in nature.





[www.exo-terra.com](http://www.exo-terra.com)

Proud sponsor of the IRCF and this centerfold

A Horned Marsupial Frog (*Gastrotheca cornuta*) with hatchlings. This species has disappeared from much of its historical range from Costa Rica to Ecuador. Breeding programs may provide a stopgap for this amazing species before it disappears forever.



good. Over one third of all amphibian species were found to be in serious decline. Another 23% were considered “data deficient,” and presumed threatened. That brings the number to nearly 50% of amphibian species that are threatened with extinction. In addition, over 100 species were declared extinct, and hundreds more are so critically endangered that we could lose them in our lifetimes.

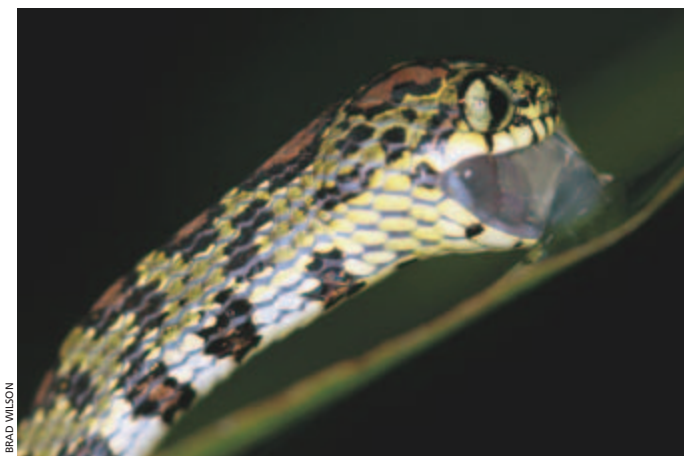
#### Why Should We Care?

With this grim picture documenting the loss of a huge part of an entire vertebrate class, the inevitable question arises: Why should we care? The answer is complex and eye opening. Amphibians serve as environmental barometers (proverbial canaries in coal mines), responding to signals that we are mistreating the planet in ways that surely will affect us in the future. We are seeing more and more reports revealing that commonly used agrochemicals, such as the herbicide atrazine, occur in our environment at levels hundreds of times higher than those needed to induce hermaphrodites and cause other mutations in amphibians (Hayes et al. 2003). Fertilizer runoff has been linked to nutrient spikes that lead to increased snail populations. These snails support parasites that interfere with proper development in amphibian larvae, resulting in deformities (Johnon and Chase, 2004). Surely, we should pay very close attention to these trends. In addition to the interactions amphibians have with agriculture, they also play a significant role in human cultures. Frogs, such as the critically endangered Panamanian Golden Frog (*Atelopus zeteki*), are thought to bring good luck and fertility. Frogs also have filtered into modern society in commercial branding for cereals, as protagonists in video games, and even in the form of an infamous bullfrog promoting adult beverages. No frog, however, is better known and revered than our friend “Kermit,” who has already hopped up to the plate and taken a stand against the extinction of his class.

*“It seems to me that if you wait until the frogs and toads have croaked their last to take some action, you’ve missed the point.”*

Kermit the Frog

Amphibians are not only barometers and cultural icons; they are crucial to the well being of the planet, human society, and individual lifestyles. Their roles are multifold. As critical links in global food webs,



Although snakes in the genus *Sibon* are usually thought of as snail-eaters, many rely on frog eggs at least seasonally. Snakes and other predators that rely on frogs to varying degrees are sure to find food supplies more scarce following the disappearance of amphibians from their habitat.

amphibians consume millions of tons of invertebrates annually and themselves become prey for larger predators. The effects are best illustrated by examining situations resulting from the removal of amphibians from ecosystems. In areas where amphibian populations have been decimated, we are just beginning to appreciate the impact. For example, in streams where amphibians and their grazing larvae have disappeared, mats of algae grow, water quality has declined (Connelly 2008) and snakes that normally eat frogs or their eggs literally starve to death (Whiles et al. 2006). The next step in this domino effect is difficult to predict, but I doubt that it will be pretty.

We have much to lose with the disappearance of amphibians. As pharmaceutical treasure chests, amphibians have already supplied human medicine with many useful and important chemicals. From antibiotics and analgesics to compounds that block the transmission of HIV, the thin skin of amphibians has produced many exciting biomedically active products — but both the amphibians themselves and their chemicals are disappearing. Many species have already gone extinct before we could determine what possible biomedical contributions they might have made. Certainly, keeping amphibians on the planet is in everyone’s best interest.

#### What We Can Do: Conservation Action

In response to the IUCN Global Amphibian Assessment and the need for immediate action to curb pending amphibian extinctions, the Amphibian Conservation Summit was held in 2005 to develop a solution. This historic meeting brought together scientists, policy makers, conservationists, and other interested parties, and led to the Amphibian Conservation Action Plan (ACAP), a \$400-million bailout for amphibians (Gascon et al. 2007). The plan, perhaps the most ambitious of its kind for any conservation action, contains directives and action plans to mitigate major known threats to amphibians. The ACAP specifically outlines work to protect key habitats and areas of biodiversity, addresses issues such as disease, climate change, and pollution, and continues to promote assessments and emergency response activities to prevent extinctions. Conducting this work will require not only scientific expertise and funding but also an effort on the part of each of us to improve environments for amphibians by lessening our impact on the planet. Implementation of the ACAP has not been easy, especially since funding for the initiative is relatively scarce and the necessary global coordination is a monumental task.

#### The Amphibian Ark

The Amphibian Ark (AArk), an organization formed by the Captive Breeding Specialist Group (CBSG), World Association of Zoos and Aquariums (WAZA), and the IUCN/SSC Amphibian Specialist Group (ASG), has been tasked with implementing the *ex situ* portion of the ACAP (Zippel et al. 2006). Amphibian Ark’s vision is to assure that amphibians are safe in nature for the long term. The organization’s strategy is to safeguard those species that are threatened in nature via global partnerships that establish short-term *ex situ* breeding programs until those threats can be mitigated. In fulfilling its mission to protect amphibians, AArk encourages, facilitates, and helps fund practical delivery of *ex situ* programs through partnerships involving AArk members, national governments, and regulatory authorities. This process requires global coordination, species prioritization, and training in addition to fundraising (to facilitate range-country programs, for example) and outreach (raising global aware-



ness of the amphibian crisis through the 2008 “Year of the Frog” campaign). The organization is small, has only a limited staff and depends on many volunteers. Oversight comes from an executive committee of leaders from each of its three parent organizations. Additional assistance comes from a steering committee with representatives from zoos, aquariums, botanical gardens, and academia. This diverse group helps AArk sustain a more holistic approach to amphibian conservation as it pertains to environmental stewardship, research, and global strategies. Currently the AArk organization has five employees: Program Officer (Dr. Kevin Zippel), two Taxon Officers (Dr. Richard Gibson and Dr. Kevin Johnson), one Training Officer (Ron Gagliardo), and one Research Officer (Dr. Robert Browne).

AArk emphasizes *ex situ* programs in the range countries of the species with solid links to *in situ* activities that promote the protection and restoration of species in natural habitats. Developing these programs is challenging. When lack of staff, funds, or expertise stand in the way of progress in range countries, AArk attempts to fill the gaps. AArk assists with species evaluations and selection in range countries (or regions) through workshops that use a prioritization tool developed collaboratively by AArk partners around the world. Once the range country has a list of *ex situ* priorities, it moves to the next step of identifying local participants, out-of-country partners, and other resources needed to carry out *ex situ* activities. AArk helps provide partners, husbandry training, and other resources to get things moving. In some cases, a lack of basic natural history information creates challenges to managing populations under *ex situ* conditions. How do we successfully manage a species in captivity for restoration work if we do not know how it lives in nature and data on how to maintain or breed these taxa are unavailable? Using related species as surrogates, we can gain valuable husbandry experience to apply in programs involving their critically endangered counterparts. For example, AArk members at the Atlanta Botanical Garden have

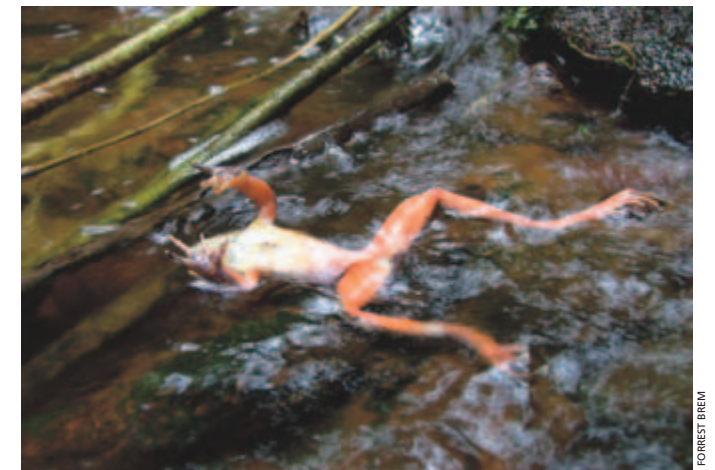


A laboratory in a modified shipping container at the Atlanta Botanical Garden helps scientists manage *ex situ* populations under strict biosecurity outside of their range countries.

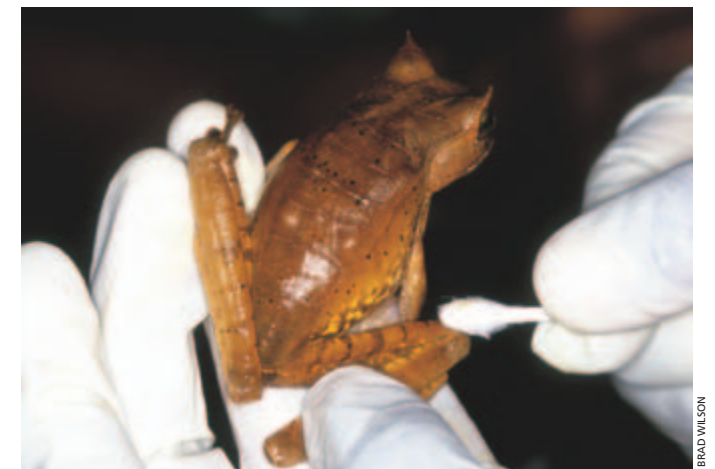
worked out protocols for maintaining and breeding common species of centrolenids (glass frogs) that are used by range country partners in Panama to advance their programs. In a similar collaborative venture, Project Golden Frog, *ex situ* partners in several U.S. zoos worked out care and breeding guidelines for the critically endangered Harlequin Frog (*Atelopus zeteki*) and have provided this information to range country researchers working with other species of *Atelopus*.

#### 2008 Year of the Frog: What We Accomplished

A global publicity and fundraising campaign, “2008 Year of the Frog,” was launched to increase global awareness of the issues that threaten amphibians and to help raise funds for responding to the crisis. Although the educational aspects were global, the capital campaign was managed largely on a local level for more regional programs. Corporate partners, such as Clorox and the Discovery Channel, helped immensely. The campaign was fronted by world-renowned celebrities that included Sir David Attenborough, Jean-Michel Cousteau, and Jeff Corwin, all of whom emphasized the urgency of this crisis to the public. Some of the accomplishments of the campaign and of AArk to date include:



Amphibian chytridiomycosis decimates amphibian populations in natural habitats quickly and is currently unstoppable in nature.



Surveying for the fungus that causes amphibian chytridiomycosis is possible with a cotton swab and a molecular assay in a laboratory. Here a Horned Marsupial Frog (*Gastrotheca cornuta*) is swabbed for subsequent testing.





Centrolenids or Glass Frogs, such as this *Hyalinobatrachium vireovittatum* from Panama, are highly susceptible to chytridiomycosis due in part to their association with riparian habitats.

- AArk conducted 11 prioritization and three training workshops.
- AArk partners currently are working with over 40 species in various capacities.
- 85 rescue populations have been established.
- \$1 million in advertising equivalents have been raised.
- \$4.4 million have been spent on *ex situ* programs.
- \$868,000 has been spent on *in situ* programs.
- 15 biosecure facilities have been added.
- Over half a million website visits have been clocked.
- Over \$12 million have been pledged over the next five years to support amphibian conservation worldwide.

#### The Future of Amphibian Ark

Many challenges remain for amphibians and their habitats despite an ever-increasing awareness and appreciation of their plight. With nearly 500 species on the verge of extinction, AArk has much to do. AArk would be thrilled to work its way out of a job by conquering the threats currently facing amphibians.

What AArk hopes to accomplish is to save hundreds of species from extinction, develop capacity in institutions globally to provide amphibian species with care and protection as needed, and form true partnerships between *ex situ* and *in situ* components of conservation. If successful, AArk will have created a model framework for responding to future conservation crises and demonstrated to the world that zoos and aquariums are essential conservation organizations. These efforts will require continued fundraising on both grassroots and corporate levels. Of over 1,200 zoological institutions in the world, only a fraction is capable of saving even one species. In the best-case scenario, the current global capacity is 50 species. Clearly, more resources (funds,

facilities, trained staff) will be required to see this to the next level. AArk will work incrementally to increase these numbers and involve more people. Although AArk is small in terms of staff and advisors, the potential amount of effort capable of being put forth by our partners around the world is huge — but ongoing support of local zoos and other institutions is critical if human societies are to rise and meet the challenges of conservation and environmental stewardship.

Amphibian Ark currently is a global network comprised of zoos, aquariums, botanical gardens, and other such institutions, but hopes to metamorphose into a membership-based organization that anyone can join, from a 3rd-grader concerned about the frogs in the creek that runs through her backyard to school classes in Colombia fearful of losing national natural treasures, and presidents and other heads-of-state. Because we all, knowingly or not, have a vested interest in amphibians and their environments, “we are ALL part of Amphibian Ark!” (Zippel 2008).

Amphibians hold a special place in the hearts and lives of many of us. Nearly everyone can relate to amphibians, especially frogs. Few children have grown up without chasing frogs or falling asleep to a melodic (or sometimes raucous) nighttime chorus. From the Frog Prince and Kermit to the Panamanian Golden Frog, frogs are deeply embedded in our collective psyche. Beyond cultural icons, their importance as environmental indicators, critical parts of the global food web, and sources of medicines should not be underestimated. Amphibians have survived on this planet for millions of years — and now, largely as a consequence of human activities, they are threatened with extinction. The amphibians are telling us that our environment



Everyone can be part of the Amphibian Ark, including upcoming young authors like Laura Elizabeth Seydel, whose recent book, *Our Friends, the Frogs*, details the amphibian crisis from a new perspective.



Although most of the news about amphibians in trouble deals with those in tropical areas, temperate-zone species such as the Chiricahua Leopard Frog (*Rana chiricahuensis*) also are threatened with extinction.

has some serious problems and, if we don't act quickly, not only the frogs will go extinct!

#### References

- Connelly, S., C.M. Pringle, R.J. Bixby, R. Brenes, M.R. Whiles, K.R. Lips, S. Kilham, and A.D. Huryn. 2009. Changes in stream primary producer communities resulting from large-scale catastrophic amphibian declines: Can small-scale experiments predict effects of tadpole loss? *Ecosystems* 11:1262–1276.
- Gascon, C., J.P. Collins, R.D. Moore, D.R. Church, J.E. McKay, and J.R. Mendelson III (eds.). 2007. *Amphibian Conservation Action Plan*. IUCN/SSC Amphibian Specialist Group. Gland, Switzerland, and Cambridge, United Kingdom.
- Hayes, T., K. Haston, M. Tsui, A. Hoang, C. Haeffle, and A. Vonk. 2003. Atrazine-induced hermaphroditism at 0.1 ppb in American leopard frogs. *Environmental Health Perspectives* 111:568–575.



The natural history and biochemical properties of many amphibians, such as this Tropical Climbing Salamander (*Bolitoglossa* sp.) from Panama, are not fully known and many could become extinct before such properties are elucidated.

IUCN (International Union for the Conservation of Nature and Natural Resources). 2008. 2008 IUCN Red List of Threatened Species. <[www.iucnredlist.org](http://www.iucnredlist.org)>.

Johnson, P.T.J. and J.M. Chase. 2004. Parasites in the food web: Linking amphibian malformations and aquatic eutrophication. *Ecology Letters* 7:521–526.

Whiles, M.R., K.R. Lips, C.M. Pringle, S.S. Kilham, R.J. Bixby, R. Brenes, S. Connelly, J.C. Colon-Gaud, M. Hunte-Brown, A.D. Huryn, C. Montgomery, and S. Peterson. 2006. The effects of amphibian population declines on the structure and function of Neo-tropical stream ecosystems. *Frontiers in Ecology and the Environment* 4:27–34.

Zippel, K.C. and J.R. Mendelson III. 2008. The amphibian extinction crisis: A call to action. *Herpetological Review* 33:23–29.

Zippel, K.C., R. Lacy, and O. Byers (eds.). 2006. CBSG/WAZA Amphibian *ex situ* Conservation Planning Workshop Final Report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, Minnesota.



Endangered Horned Marsupial Frogs (*Gastrotheca cornuta*) breed by direct development; females carry fertilized eggs in pouches on their backs and eggs hatch fully-developed froglets.





The author surveying dry shrubland habitat in government land designated for a nature reserve.

DOUG BELL

## CONSERVATION NEWS

# One Species That Will Be Saved: The Grand Cayman Blue Iguana

Fred Burton

Blue Iguana Recovery Program

Tremendously exciting news has just broken on Grand Cayman, where the Cayman Islands government has taken decisive action to save the world's most endangered iguana. Almost 200 acres of prime dry shrubland habitat in the eastern interior of the island is being protected by a 99-year lease agreement from the government to the National Trust for the Cayman Islands.

The decision by the government is the culmination of many years of planning and discussion with all of the partners in the Blue Iguana Recovery Program (BIRP). Most recently, the third version of the Species Recovery Plan for the Grand Cayman Blue Iguana (*Cyclura lewisi*) revolved almost entirely around the issue of protected land.

Operating under the aegis of the National Trust, and partnering with the local Department of Environment and the QE II Botanic

Park, the BIRP has achieved remarkable progress over the last seven years, bringing the wild population of Blue Iguanas from scarcely a dozen in 2002 to some 250 in the wild by 2009. Supported also by its international partners, especially the International Reptile Conservation Foundation and the Durrell Wildlife Conservation Trust, the BIRP completed a pilot restoration of wild Blue Iguanas in the QE II Botanic Park, and then deployed its tried and tested techniques to embark on large-scale population restoration in the Salina Reserve.

The Salina Reserve is a 625-acre wilderness area in the north-eastern interior of Grand Cayman. It is protected by the National Trust, and includes areas of sawgrass wetland, buttonwood swamp, and a significant stand of dry forest. Blue Iguana habitat (Grand Cayman's dry "xerophytic" shrubland) is at most 85 acres, account-



JOHN BINNS

The provision of protected land suggests that Grand Cayman Blue Iguanas can be saved from extinction.

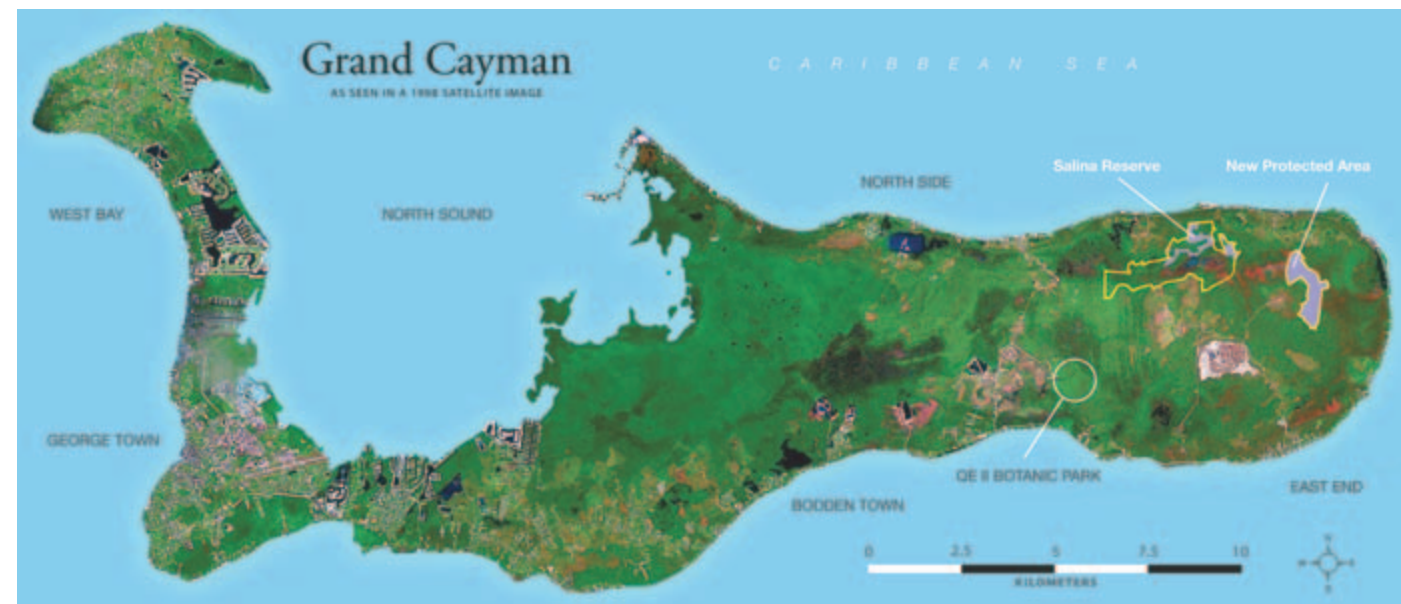




The Species Recovery Plan for the Grand Cayman Blue Iguana revolves almost entirely around the issue of protected land.

ing for less than 14% of the Salina Reserve. This severely limits the extent to which a self-sustaining wild population of Blue Iguanas can be restored there.

By 2008, the BIRP was in danger of losing momentum, with the Salina habitat approaching carrying capacity. The Program had already been forced to slow down the rate of releases in order to bal-



Government land designated for a new dry shrubland nature reserve will become the third area to support released Grand Cayman Blue Iguanas. Purple shading shows good Blue Iguana habitat.



Although formidable and intimidating for human visitors, a proposed visitor center will emphasize the importance of the rugged karst landscape for conserving Grand Cayman's native biota.

ance genetic contributions from all possible family lines before the population grew too large to accept more iguanas. Without more protected land becoming available, population restoration for the Blue Iguanas was about to stall.

Fortunately, at the same time, years of work in many areas were beginning to pay off. A long-latent European Union grant proposal, shared with the Turks & Caicos Islands and the British Virgin Islands, finally came together in 2008. In the Cayman Islands, the project promised funds to build a visitor center for a proposed new nature reserve featuring the dry shrubland ecosystem — and the Grand Cayman Blue Iguana. The Cayman Islands Government agreed in principle to support the project by contributing government land for the protected area.

From principle to practice was still a long road, beginning with some false starts and disappointments, but gradually a concept that seemed viable gained general acceptance and progressed within the government to a formal proposal to the cabinet. On (date date date) the BIRP and all its partners were overjoyed to hear the news that a new protected area was to become a reality.

In effect, this opens the final chapter in the bid to save the Grand Cayman Blue Iguana from extinction. All of the ambitious elements of the current Species Recovery Plan now look to be fully viable, and the BIRP's workload is set to expand tremendously in the next few years.

Especially if the Cayman Islands are successful in adding some additional adjacent land to the new protected area, enough Blue

Iguana habitat may well be available to raise the wild Blue Iguana population to a level that can be self-sustaining in the long term. A tantalizing future is in sight, where a captive breeding program may no longer be needed, and in which protected Blue Iguanas of all ages and sizes are roaming free, breeding, and sustaining their numbers without the need for constant human intervention.

From a scenario of little hope in 2002, the BIRP and its partners are now in sight of the kind of success that is all too rare in the world today. The Grand Cayman Blue Iguana can be saved from extinction, and, in a few more years, the Cayman Islands may be able to boast that they have achieved just that.



Grand Cayman's dry "xerophytic" shrubland is ideal habitat for Grand Cayman Blue Iguanas (*Cyclura lewisi*).

The Blue Iguana Recovery Program is honored and grateful to all those who have and continue to support its mission of restoring the Grand Cayman Blue Iguana to its natural habitat. Thank you!







A Giant Madagascar Chameleon (*Furcifer oustaleti*).

CREDIT

## TRAVELOGUE

# Madagascar

Seth Rudman

Department of Biology, University of Rochester, Rochester, New York

Photographs by the author.

I was handed a glass of clear liquid and knew immediately I was in trouble. The village chief looked at me expectantly, waiting for me to imbibe the strong-smelling fluid. I had already been in Africa for nearly four months and had become somewhat accustomed to the local offerings. I took a small sip and felt the burn of extremely strong homebrewed rum. The chief seemed pleased and I handed the cup back; he promptly drained it.

I had been called to meet with the chief when I had entered his small and seldom-visited village on the edge of Andohahela National Park. They hadn't had any *vazaha* (Malagasy for white foreigners) in quite a while. So, when I entered the village, I instantly became the prime attraction. At first, many were taken aback by my appearance and small children directed frightened and questioning looks at the elders. Reassured, the young children crowded around and stared in amazement at my white skin and strange clothes. They slowly grew bolder and many endeavored to touch my skin, much to the chagrin of their mothers standing nearby. This village is similar to countless others in Madagascar, a small conglomeration of houses built from local trees and grasses. Electricity and running water are luxuries of the far-off cities, while the village people rely heavily on the available natural resources to survive. Villagers sustain themselves by farming rice where water is available and corn and other vegetables where it isn't. The people are unwaveringly friendly and greet strangers with broad smiles. They humble any traveler with their ability to thrive in conditions we would view as extremely impoverished.

For anyone wishing to get out into the true wilds of Madagascar (and why else make the journey?) the local people are vital. My father, fresh off the plane from the U.S., and I learned this quickly. We had met in Antananarivo (Tana), the bustling capital city full of old taxis and large crowded markets. I had come from spending a semester



Rice drying in a small village. The abject poverty in many Malagasy villages is an eye-opener to a "vazaha" from the United States.



Trying to figure out what to make of the strange "vazaha."

abroad studying in the national park system in South Africa and considered myself prepared to rough it and do whatever was necessary to see the "real" Madagascar. My father had slightly different plans, but we were both ready for an adventure. We promptly flew north to Antsiranana (Diégo-Suarez to the French) eager to begin viewing some of the storied fauna and to escape the buzz of the Malagasy capital.

Our first national park was Montagne d'Ambre, just 27 km south of Antsiranana, and resplendent with rainforest and beautiful waterfalls. Our local guide, Zeze, immediately demonstrated his incredible eye for the local fauna. A few hundred meters into the park, he stopped and proclaimed that he had spotted a Leaf-tailed Gecko (*Uroplatus*) and he pointed just off the trail. I scanned the trees eager to see what I knew would be an incredible animal. My efforts proved fruitless until Zeze finally took pity and revealed the exact





An old French hotel in Antsiranana is a bit worn from cyclones.

location. When we finally saw the gecko, my father, not previously herpetologically inclined, and I were equally dumbfounded. The form and behavior of this animal served as perfect camouflage. As we approached, it pressed itself closer to the tree, using dermal fringes to blend seamlessly with the bark and to eliminate any noticeable edge between its body and the trunk. We continued our walk through Montagne d'Ambre, buzzing with enthusiasm.

Zeze continued to impress as he spotted a Dwarf Chameleon (*Brookesia tuberculata*), one of the world's smallest reptiles. The tiny chameleon was amusing to watch and, once captured, it feigned death, providing an excellent chance to examine it closely. It was toy-like, with small frail limbs and hard spines down its back. Despite its petite size, its form was strikingly familiar — but on an unbelievably miniature scale. With its wealth of unique, endemic biodiversity, Madagascar revealed new and exceptional things to us on each day of our trip.

Our next stop, Ankarana Special Reserve, certainly had many treasures to offer. The reserve has *tsingy*, beautiful limestone karst pinnacles, and caves filled with brilliant crystallized formations. A walk through *tsingy* is like walking lonely corridors of another planet. The limestone rises up on either side forming high walls that come to sharp points above. As we exited the *tsingy* and walked back into the forest, we came upon a group of Crowned Lemurs (*Eulemur coronatus*) close to the ground. They made some characteristic lemur grunts, similar to that of a pig, and some climbed down to investigate us (fueling our insatiable photographic appetites). After a few moments,



A Leaf-tailed Gecko (*Uroplatus henkeli*) roused from its camouflaged position.

they decided that we weren't all that interesting and departed, leaping from tree to tree away from the path and out of our sight.

The agility and speed of lemurs was something we were lucky enough to see several times. In the Perinet National Park, we came upon a group of Babakotos (*Indri indri*), the largest extant lemur. Perinet is the most heavily trafficked of all Malagasy parks due to its proximity to Tana, but its boundaries recently have been expanded to include Mantadia National Park, which is less developed. Both



A tiny Dwarf Chameleon (*Brookesia tuberculata*) exploring an unfamiliar habitat.



A Crowned Lemur (*Eulemur coronatus*) coming down for a closer look at some strange visitors.

parks revealed excellent creatures of herpetological interest, including a Painted Mantella (*Mantella madagascariensis*), a Parson's Chameleon (*Calumma parsonii cristifer*), a chameleon with more familiar dimensions, and a large sleeping Madagascan Ground Boa (*Sanzinia madagascariensis*). Mantadia is a fantastic dense primary forest, commonly used for research studies and definitely worth a visit. After our brief stay in the area, the time had come for my father to return to the U.S.

As he flew back to the comforts of home with a newfound enthusiasm (love still isn't the right word) for herpetology, I headed south alone to spend time in the Isalo and Andohahela national parks. After a long day of traveling with several delays (definitely the norm in Madagascar), I finally arrived at my hotel during a rainy night. To my surprise, music and laughter emanated from the dining area. I ventured inside and came upon a large Malagasy party. I was promptly given a room and asked to come back and participate in the festivities. My best effort to bridge the language barrier (my French is decidedly poor) led to many laughs. However, I thoroughly enjoyed watching traditional Malagasy dances and feasted on a delicious dinner of Zebu (local cattle) before heading off to sleep.

The Isalo Park is a far cry from the moist rainforest of the northern and central parks. I had planned four days of hiking to examine several of the park's beautiful canyons and the *piscine naturelle* (natural swimming pool). Each canyon proved beautiful, and the many waterfalls and pools provided excellent reprieves from the summer heat. Blue-legged Mantellas (*Mantella expectata*) were prevalent in the area and were a site to behold with their yellow heads fading to orange on the back and their metallic blue arms. Madagascar Swifts (*Oplurus cyclurus*) greeted us from perches on sandstone ledges and rock piles. The sandstone has yielded to erosion and over time has been crafted into beautiful sculptures and shallow caverns, which are used by local peoples for burials. Local customs dictate that they bury their dead in a coffin inside of a cavern for two years. The bones are then removed, washed, and then reburied in a different cavern. Madagascar has many different regional tribes, each with their own unique beliefs. These beliefs, called *fady*, extend to most facets of life and should be observed by visitors once they are known. Asking your local guide about regional *fady* is an excellent way to avoid offending any local people and also a chance for exposure to some Malagasy culture.

Unfortunately, one of the common *fady* is a belief that Malagasy snakes are dangerous. Although some mildly venomous



The fringes on the heads of Leaf-tailed Geckos (*Uroplatus henkeli*) serve to blend with the substrate.

colubrids have been reported, no native snakes pose any real danger to humans. While driving, we often stopped to examine chameleons or boas visible from the road. My driver recognized my interest in reptiles and took me to a particular village where a small snake had settled into a massive pile of cassava (the starchy roots of which are a Malagasy staple). The villagers led me to the pile hoping that I could somehow charm out the snake. With the help of my driver I tried to explain that the snake was not harmful, but I doubt that I was sufficiently convincing to overturn a long held belief. The locals were clearly disappointed at my unsuccessful snake removal efforts.

The final stop on my journey was to the far south in the Andohahela National Park. This park is one of the few areas with spiny forests, a unique biome resulting from extremely sparse rainfall and exceptionally poor soil. Nevertheless, the area features many beautiful endemic plants (some of which are spiny, hence the name). Traveling to Andohahela did prove somewhat difficult. The extremely dry spiny forest area of the park has no water and is not often visited. The cuisine pushed my limits as a traveler (since when do egg and cheese sandwiches contain all the organs of a chicken?) and the weather was exceedingly hot. Yet the scenery was certainly worth the struggle. I was able to see Verreaux's Sifakas (*Propithecus verreauxi*), another species of lemur, leap apparently unfazed onto trees covered in sharp spines. The ability of the local people to live in the arid environment with so little



A beautifully colored Panther Chameleon (*Furcifer pardalis*).





A massive Parson's Chameleon (*Calumma parsonii cristifer*), a chameleon with more traditional dimensions than the tiny *Brookesia*.



A Comet Moth (*Argema mittrei*) from Madagascar Exotique (a private park).



Diademed Sifaka (*Propithecus diadema*) in Perinet Reserve.



Large millipede in the moist Mantadia forest.



The beautifully colored Painted Mantella (*Mantella madagascariensis*).

water was inconceivable. They sustained their Zebu (cattle) with invasive cactus leaves and survived with water brought in occasionally on a Zebu-drawn cart from a river 20 km away.

Madagascar is still a wild place, a place of wonder and mystery. It may make news for the rapid decline in its biodiversity and for its degraded habitats, but many areas still support relatively unspoiled wilderness. The Malagasy people will astound any visitor with their

friendliness and can easily shift the worldview of the most ardent "ugly American." As I waited in the airport (my flight was again canceled) for my flight back to Johannesburg, I realized how accustomed I had become to Malagasy living and to seeing astounding novelties each and every day. I knew then that I would never forget the terrific people and beautiful country that is Madagascar. I began planning a return trip while still on my way home.



Holding a Dumeril's Boa (*Acrantophis dumerili*) outside of Isalo National Park, I encountered the only Malagasy I met on the trip who was truly unafraid of snakes.



Verreaux's Sifakas (*Propithecus verreauxi*) leap unfazed onto trees covered in sharp spines.



Blue-legged Mantella (*Mantella expectata*) in Isalo National Park.



The strange vegetation in Isalo National Park included this "Elephant's Foot."





KIRSTEN HINES

John Iverson's research on the behavior and ecology of Bahamian Rock Iguanas earned him a permanent position in the "iguana hall of fame." John measures a *Cyclura rileyi* from the introduced population on Bush Hill Cay in 2005.

## PROFILE

# John Iverson: Researcher, Teacher, Friend

Lynne Pieper,<sup>1</sup> Stesha Pasachnik,<sup>2</sup> and Kirsten Hines<sup>3</sup>

<sup>1</sup>University of Illinois at Chicago, Chicago, IL 60607

<sup>2</sup>University of Tennessee, Knoxville TN 37996

<sup>3</sup>The Institute for Regional Conservation, Miami, FL 33170

For almost 30 years, biologist John Iverson has successfully conducted three long-term field studies recognized throughout the world; together they represent nearly a cumulative century of work. Studies in northern Indiana focus on a variety of turtle species, work in western Nebraska examines turtles and snakes, and research in the Exuma Islands of the Bahamas investigates Rock Iguanas. Any one of these would represent the life's work of an accomplished field biologist; leading *three* studies for three decades is unprecedented. When John isn't in the field, crunching data or writing, he can be found in the classroom teaching, leading students on local field trips, or working with student curators at Earlham College's Joseph Moore Museum of Natural History. John has been a member of Earlham's faculty since 1978 and has been Museum Director since 1982.

In a quiet moment, you might find him in his office advising a student (prospective, current, or former), writing a letter of recommendation, or delicately replying to a third-grader's e-mail that

begins, "Dear Dr. Iverson, I am doing a book report on turtles. Can you tell me everything you know about turtles?" In his "free time," you will find him in the woods clearing invasive plants, reforesting a 71-acre tract that he has deeded as a conservation area, or working to reintroduce native amphibians into his many man-made ponds.

Born and raised on a horse farm near Omaha, Nebraska, John credits his maternal grandmother Betsy with fostering his wildlife interests. A highlight of his childhood was the one week every summer he spent with her fishing, camping, and exploring nearby ponds and streams, all the while gathering as many herps as possible. He reminisces, "I grew up on a farm and there were always turtles walking around, or there were ponds around with frogs and salamanders and snakes. So I always had a snake in my shirt, you know, the classic tow-headed boy with a frog in his pocket."

John attended Nebraska public schools until graduating in 1967, after which he enrolled in Hastings College, about 160 miles



LYNNE PIEPER

John's seminal Rock Iguana work in the Bahamas makes him the man to go to for information on life histories of these magnificent animals. This is an Allen Cays Iguana, *Cyclura cyclura inornata*.



west of Omaha. As an undergraduate student at Hastings, John met biology professor Gilbert Adrian. Adrian, like John's Grandma Betsy, loved wildlife and the outdoors, and had a deep and profound influence on John. "Gilbert Adrian was and is my inspiration, from his photographic memory to his energy and enthusiasm," says John. "Once I went into the field with him, I became a field biologist. He just turned me on to biology; there's no other way to put it."

John graduated *Summa Cum Laude* from Hastings College in 1971 with majors in both biology and mathematics, and a minor in chemistry. Following graduation, he married his high school sweetheart and partner for life, Sheila. The young couple immediately packed their meager possessions into a dying car and headed to Florida for John to attend graduate school at the University of Florida (UF) in Gainesville. Sheila worked first as a teacher's aide at a school 30 miles from Gainesville and then secured a teaching position at a local school. This was their only steady income for the first eight years as John entrenched himself in graduate research.

At UF, John's hard work and dedication immediately impressed his graduate advisor, Dr. Walter Auffenberg. Auffenberg knew that John did not come from a privileged background and that everything he had accomplished he had earned through hard work and persistence. He saw an intelligent, capable young man who had the talent and grit to succeed. John's master's work on geographic variation in the Musk Turtle (*Sternotherus minor*) was completed in 1974 and earned him the nickname "Turtle Guy." Soon he would begin work that earned him the further title of "Iguana-man."

Confident that John could complete his master's and take on an additional project, Auffenberg made John Assistant Investigator on his New York Zoological Society grant to study the West Indian Rock Iguana, *Cyclura carinata* in 1973. During this period, John was completing his master's, beginning the work that would lead to his Ph.D. and expanding his turtle involvement by becoming a research assistant to Dr. Archie Carr, for whom he worked on the standardization, computerization, and analysis of 20 years of sea turtle data.

After 26 weeks in the field between 1973 and 1976, John's research on the behavior and ecology of *Cyclura carinata* earned him a Ph.D. in Zoology and a permanent position in the "iguana hall of fame." This work dramatically increased our knowledge of iguana biology and natural history.

Rick Hudson, Conservation Biologist at the Fort Worth Zoo and former co-chair of the IUCN Iguana Specialist Group, touts



John Burton Iverson at home in Nebraska in 1961.



When John isn't in the field, crunching data or writing, he can be found in the classroom teaching, leading students on local field trips, or working with student curators at Earlham College's Joseph Moore Museum of Natural History.

John as the go-to guy for *Cyclura*, in part because of his *C. carinata* research. "(John's) contributions to the Iguana Specialist Group are immeasurable; John is the official repository of *Cyclura* life history data. When you talk about the vulnerability of rock iguanas to introduced mammals, you always cite his seminal work on *Cyclura carinata* in the late 1970s."

Upon completing his Ph.D. in 1977, John was hired as Adjunct Assistant Curator of Herpetology for the Florida State Museum at UF. During this time, he was principal investigator for a study of *Kinosternon* turtles and continued working with Dr. Carr analyzing data on sea turtles. As his prolific research efforts continued, John's mentoring gifts also began to blossom.

Ron Magill, now Communications and Media Director for Miami Metrozoo, was an 18-year-old undergraduate student at UF when he met John. "I was privileged to work with John at a pivotal time in my life. I was lucky enough to get a job working in the herp range at the Florida State Museum in Gainesville typing tags for all of the pickled herps that were being collected by a variety of grad students, professors, etc. I got along well with my supervisor, Peter Meylan, and, because I spoke Spanish, I was asked if I would like to go to Mexico with him and John for a mud turtle study John was doing under an NSF grant."

"There is no way to describe how special it felt to be accompanying these two legendary 'herpers' on a collecting trip to Mexico. I felt as if I had won the lottery! I'll never forget loading up all of our stuff into John's old orange and white VW bus and just hitting the road. At first, I was intimidated being with 'Dr. Iverson' and Peter, but from the get-go, they made it obvious that I was no longer the undergrad, but a real part of the team. That trip is a huge cornerstone of my successful career today. I learned more from John and Peter during three weeks in Mexico than I learned all year at the University. More than that, I have never had so much fun on an expedition as I did with John."

In 1978, John relocated to Indiana to become a biology professor at Earlham College. He continued to secure grants to study turtles and iguanas and made it a point to include students on his trips. In the summer of 1979, looking to begin new projects in the area, John embarked on a large-scale mark-and-recapture turtle project at Dewart Lake in northern Indiana. This study has resulted in many



John has been known to nod off when he runs low on Mountain Dew and Little Debbie's.

publications focusing on changes in sex ratios in musk turtles, daily activity patterns in each of the species, and long-term changes in the turtle species composition at the site.

In 1980, John began exploring the natural history of Ornate Box Turtles (*Terrapene ornata*) and Yellow Mud Turtles (*Kinosternon flavescens*) among many other species of turtles, snakes, and lizards at the Crescent Lake National Wildlife Refuge in the sandhills of western Nebraska. John knew that this was the perfect site for a long-term study because it was remote and the animal populations were relatively undisturbed. The area's designation as a National Wildlife Refuge made it unlikely that housing developments or highways would be built there. "The data that we've collected on turtles in western Nebraska [shows] that some of these turtles live for 75 years or longer," John explains. "We've found one of the species of turtles that's out there is the only turtle species in the world that nests while it is underground. It crawls up into the hills and buries itself completely underground for several days. Then while it's buried, it digs a nest underground and then it digs back out and moves back to the water. No other turtle in the world does that." In addition to gaining a better understanding of these species' basic biology, long-term studies of relatively undisturbed turtle populations provide benchmarks for comparison with data from populations increasingly



John and Ron Magill with a trap full of Mud Turtles (*Kinosternon*) in 1978.

impacted by humans. The conservation implications of this type of work are vast.

Herpetologist Peter Meylan is R.R. Hallin Professor of Natural Sciences at Eckerd College in St. Petersburg, Florida. He started as an undergrad at UF at the same time that John started as a grad student. He explains, "John is one of the world's leading authorities on freshwater turtles. He has studied and written about turtles belonging to most living families, but is particularly well-known for his work on the families Kinosternidae (mud and musk turtles) and Geoemydidae (Old-World pond turtles). John's work as a turtle ecologist is also well known. His study of the Yellow Mud Turtle in the Nebraska sandhills makes this one of the most completely known life histories of any turtle species. He has also published important ecological studies of Painted Turtles, Ornate Box Turtles, and others, as well as summary papers that have reviewed patterns of survivorship, growth, maturation, and species richness of turtles world-wide. He was recently a major contributor to a workshop on *Genetics, Ethics, and Taxonomy of Tortoises and Freshwater Turtles* held at Harvard. As a part of that workshop, he led the effort to try to compile a single tree of life for all turtles."

Wanting to continue his work with rock iguanas, John started a new *Cyclura* project in 1980 focusing on the Allen Cays Rock Iguana (*C. cyclura inornata*) in the Bahamas. For the first two expeditions, John arranged a team through the Center for Field Research (Earthwatch). With subsequent trips, he has recruited field assistants from among his growing pool of current and former students.

This study remains ongoing and is now one of the longest, continuous field studies of any lizard in the world. John's dedication and work on this species have yielded numerous publications on the life history and ecology of this critically endangered iguana, information that has proved vital for developing conservation plans for this and other species.

In 1986, John self-published a book entitled *Checklist with Distribution Maps of the Turtles of the World* (revised and reprinted in 1992). This publication represents a compilation of all locality records from colleagues, museums, and the literature for each of the world's turtle species. John started amassing this information in 1972 and this book is still a standard reference for turtle biologists around the world.



As if launching field studies, teaching and publishing were not enough, John and his wife started a family during this period. Sons Peter and Matthew (born in 1984 and 1987) grew up alongside a myriad of animals and college students. They spent summers driving across the country and exploring the wild beauty of western Nebraska, joining the team as John's youngest field assistants, while Sheila made sure base camp was operational.

In 1989, with funding from the EPA and NSF (through Oregon State University), an electronic version of John's *Checklist with Distribution Maps of the Turtles of the World* went on-line. Designed for conservationists and researchers, but available to all who have an interest, the site remains an invaluable source of timely and comprehensive information about taxonomic and distribution data for the world's 200-plus land and freshwater turtles.

John is world renowned for his work with iguanas, turtles, and a slew of other creatures. In the last ten years alone, he has served as reviewer for 18 scientific journals including *Biological Conservation*, *Ecology*, *Copeia*, and *Herpetologica*. Biologists have paid tribute to his many contributions to the scientific field by naming several new species after him. He has published over 150 papers in which he is the first author and countless more where he is part of a collaborative effort with other professors, professionals, and students. As Ron Magill pointed out above, John never thinks of people in a hierarchical manner, everyone brings something unique and interesting to the table, and everyone is an equal when doing science with John.

John's talent as a teacher and mentor who engages and inspires others reflects a deeply held belief in the critical connection between science and education. "It is not enough simply to *teach* students about science. Rather, we must teach students how to *do* science," John explains. He describes himself not as a teacher so much as "an assistant in learning." "Collaboration in and out of the classroom is of utmost importance to me," John says. He believes that the "synergistic educational relationships" allow all those involved to "learn more and teach better than (they) possibly could alone." Former Earlham College Provost Len Clark states, "He is truly a teacher and scholar with unusual reach and influence."

"John epitomizes what it means to be a great teacher," says biologist Geoff Smith. Under John's guidance, Geoff was challenged by the opportunity to take a junior-level course, Vertebrate Zoology, his first year at Earlham College. "My own courses that I now teach (at Denison

University), including Vertebrate Zoology, can trace their roots back to that class and how John got his students engaged in doing biology," says Geoff. "I owe much of my success as a faculty member at a liberal arts school to what I learned from John as an undergraduate."

Many of John's students look to him and see him in the same light that he saw his undergraduate mentor, Gilbert — passionate, dedicated and inspirational. "I can remember one incredibly cold, rainy night in the field with John in southern Indiana," recalls Stesha Pasachnik (currently completing a Ph.D. focusing on iguana conservation). "John had found me earlier in the day and told me that the amphibians were moving and we had to go. Classes ended, we loaded the van with equipment and we hit the road. Reaching the field site, it was clear that John couldn't have been more correct. We could barely get the van to the ponds because the roads were alive with amphibians. Finally reaching the ponds, the sight was magnificent. Spotted Salamanders seemed to be dancing to the beat of the raindrops, swimming effortlessly to the surface for a bit of air, and then plummeting rapidly back to the action on the pond floor. I had never seen anything like it. John had opened my eyes to a career path that I did not know was possible."

Hundreds of students have traveled with John to conduct research in Indiana, more than 50 have made the journey with him to Crescent Lake in Nebraska, and approximately 200 have assisted with research in the Exuma Islands of the Bahamas. Today, with roughly one-fifth of the graduates having majored in biology, Earlham ranks eighth nationally (between Johns Hopkins and the Massachusetts Institute of Technology) in the percentage of its biology majors who eventually have gone on to earn a doctorate in the field. John has been critical in this process and was recognized formally for his "extraordinary dedication to undergraduate teaching" when the Carnegie Foundation named him the 2005 Indiana Professor of the Year for the Advancement of Teaching.

John also has influenced students at other institutions, at times even before meeting them in person. Chuck Knapp (currently a CRES post-doctoral fellow) recalls. "Prior to entering graduate school, I wrote a brief article concerning an iguana survey conducted in the Exumas and sent it to John for review. Though John did not even know me, he painstakingly edited and commented on the manuscript." Chuck still has the original marked copy, his first of many lessons from John.



John's drift fence funneled an Eastern Yellow-bellied Racer (*Coluber constrictor*) into a trap at Crescent Lake National Wildlife Refuge, Nebraska.



Pulling a "Snapper" (*Chelydra serpentina*) out of a net at Rattlesnake Pond, Nebraska in 2006. "A turtle by the tail is worth two in the pond."



Not afraid to get dirty, John inspires students to attempt feats of daring they were convinced they couldn't do. Here he digs up a *Cyclura cyclura inornata* burrow looking for eggs in 2007.

Somehow, amidst all this drive and achievement, John manages to connect with and inspire people in a very real way. Even sitting in John's office, students watch salamanders splashing in buckets or the Alligator Snapper on the desk. In the field, their hearts sputter as John abruptly stops on the highway, reverses, swerving around oncoming traffic to show off an armadillo or capture a Diamondback Rattlesnake. John brings out the adventurer in all who surround him. Lynne Pieper (another former student of John's, currently a doctoral student at the University of Illinois) explains, "John's like a televangelist-herpetologist — he really gets you going! He catches animals that no one can catch and doesn't get bitten when by every law of animal behavior he should. He inspires us to do what we thought we could not or should not do — go after an iguana down a hole, up a poisonwood tree, or in the middle of a thicket of thorny scrub bushes. Every instinct in your intellect tells you 'Danger, danger!' — that this is *not* a good situation for capturing an animal. Yet John asks the capture team, 'Well, who's going in?' Suddenly, all of the clear-thinking primates who moments ago had determined that this was *not* a good idea, check their common sense at the door. 'Sharp rocks, be damned.' 'Pus-filled-welt-inducing poisonwood, be cursed.' 'Thorns and spines — I defy you.' Amidst a cavalcade of yells and curses, we all spring forward to catch the iguana."

John is a scientist whose passions run deeper than research. He truly loves the animals with which he works and readily sparks that

enthusiasm in those around him. In western Nebraska, every quarter-sized mud turtle hatchling in a pit fall trap is a little miracle; on U-Cay in the Exumas, every capture is a new challenge; in his own backyard, every salamander returning to his ponds is incredible. The novelty never wears off for John, and he strives to share this appreciation with future generations. John has not only advanced many fields of research in ways recognized around the world, he has created an army of researchers, teachers, and activists inspired to do great things.

John and his wife Sheila have dedicated their lives to making a positive impact on the world. As if the global influences of John's professional endeavors were not enough, they have also executed a conservation easement on 71 acres of native Indiana ravine forest the couple purchased southwest of Earlham College's campus. The easement not only promises that many native amphibians and reptiles will always have a safe haven in which to thrive, but also that students will have continued access to wild areas for generations to come. Even at home, John has created the perfect scenario for research, teaching, and friendship.

#### Authors' Note

John has had a dramatic influence on the three of us and we know that's also true for many others, Earlham students being just a small fraction of the number who have had their lives molded by interactions with John. He truly is much more than an amazing researcher and phenomenal mentor — he's one of the most caring and attentive friends you could ever wish to have. As a small thank you for all he's done for us personally, but also for his vast contributions to the planet as a whole, we wrote this paper, unbeknownst to him, as a tribute at the 30-year juncture of his three projects. All three of us have been lucky enough to experience each of these studies, and we look forward to many more years of volunteering on his projects! John, thanks for everything.

#### Acknowledgements

We would like to thank Rick Hudson, Sheila Iverson, Dr. Charles Knapp, Ron Magill, Dr. Peter Meylan, and Dr. Geoffrey Smith for their contributions. John Iverson's quotations are reprinted courtesy of Hastings College and the Public Affairs staff of Earlham College.



Every quarter-sized Mud Turtle (*Kinosternon flavescens*) hatchling is a little miracle.



## BOOK REVIEW

## Animals Make Us Human

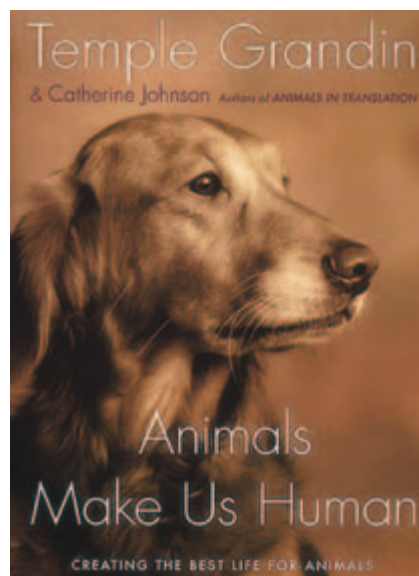
*Animals Make Us Human: Creating the Best Life for Animals.* 2009. Temple Grandin and Catherine Johnson. Houghton Mifflin Harcourt. Boston New York. 342 pp. Hardback – ISBN: 978-0-15-101489-7. \$26.00

For anyone who claims to love animals and has spent any amount of time observing their behavior, this book is essential. Although none of the ideas presented herein are startling or revolutionary, the way in which they are presented, in straightforward, simple language, yet backed by solid scientific observation and research, could very well change the way that ordinary people relate to the animals they keep as pets and use for food.

The initial chapter, “What do animals need?” presents the findings of the British-government commissioned study on intensive animal production (big farms raising large numbers of animals for slaughter). The study concluded that animals had needs in the areas of both physical welfare (freedom from hunger and thirst, discomfort, pain, injury or disease) and mental welfare (freedom to express normal behavior and freedom from fear or distress). In this book, Grandin is largely focused on defining and describing the mental welfare needs of animals in terms of their core emotions. These core or “Blue-ribbon emotions,” as she calls them, are defined by neuroscientists as those that “generate well-organized behavior sequences that can be evoked by localized electrical stimulation of the brain.” These emotions can be negative, such as, RAGE, FEAR, and PANIC, or they can be positive, such as, SEEKING, “the basic impulse to search, investigate, and make sense of the environment.”

The book continues with chapters on dogs, cats, horses, cows, pigs, chickens and other poultry, wildlife, zoos, and an afterword entitled: “Why do I Still Work for the Industry.” Dr. Grandin is, after all, an acclaimed professor of Animal Science, best known for her work designing slaughterhouses that minimize stress on the animals being processed.

Each of her animal models looks at the dominant emotions in terms of natural behavior, such as social characteristics: dogs are hyper-social, cats less so; horses are herbivorous prey animals prone to fleeing, and cows are herbivorous prey animals prone to bunching together for safety. Some species thrive well in large groups (cows), other in small groups of “familiar individuals” (horses and pigs). Dogs and pigs have a high need for SEEKING, while novelty can send a horse into PANIC. For each group of animals, Grandin describes methods of husbandry (and transport and slaughter where appropriate) that minimize the negative emotions of RAGE, FEAR, and PANIC, while providing just enough novelty to trigger the positive emotion of SEEKING.



As a long time observer of reptilian behavior in artificial conditions. I'm thoroughly convinced that neuroscientists could evoke those same “well-organized behavior sequences” in iguanas and other reptiles. Like horses, they are herbivorous prey animals prone to fleeing; like dogs, I see them developing dominance hierarchies when kept in unnatural groupings and I see them thriving in groups of familiar individuals; and, like pigs, they have a need for novelty (especially *Cyclura*) to stimulate SEEKING.

Because they are so prone to fear, I have always seen my job (beyond providing for the iguanas' physical welfare) as providing them with an environment in which FEAR is minimized and in which they can become acclimated to life in captivity (which is far from natural for them!). Arboreal Green Iguanas need a high perch from which to scan for predators, whereas terrestrial Spiny-tailed Iguanas need a slightly raised spot on the ground. Both need a safe place to which they can flee in the face of perceived danger. If unable to flee, they respond with PANIC.

Rock Iguanas (*Cyclura*) need large amounts of space in order to engage in the natural behavior of exploring their environment (SEEKING). They need to discover “safe” spots (whether in a drawer, on a shelf in a coat closet, or behind a dresser). Keeping them confined in too small a space will often provoke RAGE.

In her chapter on wildlife, Grandin expounds on the necessity for good fieldwork in order to protect wildlife and manage complex environmental systems. We can only understand the needs of animals and establish conservation goals by observing their behavior at first hand and seeing how they interact with their environment. Ever the behaviorist, Grandin points out that you “can't pass laws against human nature” and that conservation needs to be economically valuable to the local human populations.

*Animals Make Us Human* is written in very down-to-earth language and any scientific terms are well explained; this volume is meant to appeal to a broad audience. For me, Grandin is an example of the best kind of scientist. Her observations are detailed and thorough, her methods rigorously scientific, and her conclusions logical. Yet she never loses touch with her love and compassion for her subjects, whether they are dogs, cats, sheep, or pigs. Understanding the behavior of our fellow creatures can only help us see the horse or chicken in our own behavior. The quality of life we offer our animals (in captivity and in the wild) is indeed an indication of our own humanity.

AJ Gutman

## ADVERTISEMENTS



kingsnake.com  
Online Since 1997



## CONSERVATION RESEARCH REPORTS

### Agricultural Contaminants Alter Gonadal Form and Function in Cane Toads

Many agricultural contaminants disrupt endocrine systems of wildlife. However, evidence of endocrine disruption in wild amphibians living in agricultural areas has been controversial. Typically, studies on the effects of pollutants on wildlife attempt to compare polluted with unpolluted sites. MCCOY ET AL. (2008. *Environmental Health Perspectives* 116:1526–1532) took a novel approach to addressing this question by explicitly quantifying the relationship between gonadal abnormalities and habitats characterized by differing degrees of agricultural activity. They quantified the occurrence of gonadal abnormalities and measures of gonadal function in at least 20 Cane Toads (*Bufo marinus*) from each of five sites that occur along a gradient of increasing agricultural land use. The number of abnormalities and frequency of intersex gonads increased with agriculture in a dose-dependent fashion. These gonadal abnormalities were associated with altered gonadal function. Testosterone, but not estradiol, concentrations were altered, and secondary sexual traits were either feminized (increased skin mottling) or demasculinized (reduced forearm width and nuptial pad number) in intersex toads. Based on the end points the authors examined, female morphology and physiology did not differ across sites. However, males from agricultural areas had hormone concentrations and secondary sexual traits that were intermediate between intersex toads and nonagricultural male toads. Skin coloration at the most agricultural site was not sexually dimorphic; males had female coloration. Steroid hormone concentrations and secondary sexual traits



The frequency of gonadal abnormalities in Cane Toad (*Bufo marinus*) tadpoles increased with exposure to agriculture.

correlate with reproductive activity and success, so affected toads likely have reduced reproductive success. These reproductive abnormalities could certainly contribute to amphibian population declines occurring in areas exposed to agricultural contaminants.

### A Cocktail of Contaminants: How Mixtures of Pesticides Affect Aquatic Communities

The ubiquity of anthropogenic chemicals in nature poses a challenge to understanding how they affect ecological communities. Communities are exposed to suites of contaminants, yet investigations of the effects of diverse contaminant mixtures in aquatic communities are rare. RELYEA (2009. *Oecologia* 159:363–376) examined how a single application of five insecticides and five herbicides at low concentrations affected aquatic communities composed of zooplankton, phytoplankton, periphyton, and larval amphibians (Gray Treefrogs, *Hyla versicolor*, and Leopard Frogs, *Rana pipiens*). The author examined each pesticide alone, a mix of insecticides, a mix of herbicides, and a mix of all ten pesticides. Individual pesticides had a wide range of direct and indirect effects on all groups. The impact of pesticide mixtures could largely be predicted from the effects of individual pesticides for zooplankton and algae, but not for amphibians. An apparently direct toxic effect of endosulfan caused 84% mortality of Leopard Frogs and an indirect effect induced by diazinon caused 24% mortality of Leopard Frogs. When pesticides were combined, the mix of herbicides had no negative effects on the survival and metamorphosis of amphibians, but the mix of insecticides and the mix of all ten pesticides eliminated 99% of Leopard Frogs. Interestingly, these mixtures did not cause mortality in Gray Treefrogs, which grew nearly twice as large due to reduced competition with Leopard Frogs.

### Translocating Amphibians and Reptiles

Translocations can be important tools for conservation. Despite increased use over the last few decades, the appropriateness of translocations for amphibians and reptiles has been debated widely over the past 20 years. To provide a comprehensive evalua-



Larval Leopard Frogs (*Rana pipiens*, top) were very vulnerable to low dosages of pesticides, especially when subjected to mixtures of them. In sharp contrast, Gray Treefrog (*Hyla versicolor*) larvae resisted the toxic effects of contaminants and grew nearly twice as large in the absence of competition with Leopard Frogs.

tion of the suitability of amphibians and reptiles for translocation, GERMANO AND BISHOP (2009. *Conservation Biology* 23:7–15) reviewed the results of amphibian and reptile translocation projects published between 1991 and 2006. The success rate of amphibian and reptile translocations reported over this period was twice that reported in an earlier review in 1991. Success and failure rates were independent of the taxonomic class (Amphibia or Reptilia). Reptilian translocations driven by human-wildlife conflict mitigation had a



A current review of translocation projects showed that recent efforts, such as those involving Gopher Tortoises (*Gopherus polyphemus*), have been more successful than those evaluated by a similar review in 1991.

higher failure rate than those motivated by conservation. Outcomes of amphibian translocations were significantly related to the number of animals released, with the most successful projects releasing over 1,000 individuals. The most common reported

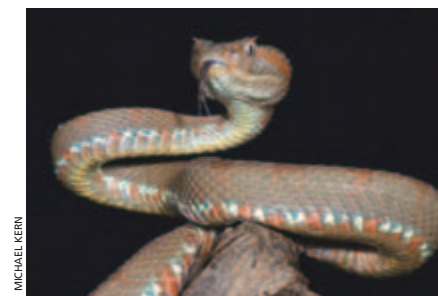
causes of translocation failure were homing and migration of introduced individuals out of release sites and poor habitat. The increased success of amphibian and reptilian translocations reviewed in this study compared with the 1991 review is encour-

aging for future conservation projects. Nevertheless, more preparation, monitoring, reporting of results, and experimental testing of techniques and reintroduction questions need to occur to improve the likelihood of future success.

## NATURAL HISTORY RESEARCH REPORTS

### Vipers and Predator-prey Dynamics

Snakes typically are not considered top carnivores, yet they are major predators in many ecosystems. NOWAK ET AL. (2008. *Biological Reviews* 83:601–620) assessed traditional views of predator-prey dynamics to determine if they were consistent with what we know about vipers and pitvipers (Viperidae). Specifically, the authors compared behavioral and physiological characteristics of vipers with those of more commonly studied mammalian (endothermic) predators and discussed how functional and numerical responses of vipers are fundamentally different. Generally, when compared to similar-sized endothermic predators, vipers have: (i) lower functional responses owing primarily to longer prey-handling times resulting from digestive limitations of consuming large prey and, for some adults, tolerance of fasting; (ii) stronger numerical responses resulting from higher efficiency of converting food into progeny, although this response often takes longer to be expressed; and (iii) reduced capacity for rapid numerical responses to short-term changes in prey abundance. Given these factors, the potential for viperids to regulate prey populations would most likely occur when prey populations are low.



Viperids (which include vipers and pitvipers, such as this Palm Pitviper, *Bothriechis supraciliaris*) are major predators in many ecosystems, but probably have the capacity to regulate prey populations only when they are low.



An adult male pink iguana (*Conolophus* sp.) on the rim of Volcano Wolf (1700 m), Isabela island.

### A Pink Land Iguana in the Galápagos

The Galápagos Islands are not yet depleted of evolutionary novelties. When Darwin visited the Galápagos, he observed both Marine (*Amblyrhynchus*) and Land (*Conolophus*) iguanas, but did not encounter a rare pink black-striped land iguana (herein referred to as “Rosada,” meaning “pink” in Spanish), which, surprisingly, remained unseen until 1986. GENTILE ET AL. (2009. *Proceedings of the National Academy of Sciences of the United States of America*, published online 05 January 2009; doi: 10.1073/pnas.0806339106) demonstrated that substantial genetic isolation exists

between Rosada and syntopic yellow forms and that Rosada is basal to extant taxonomically recognized Galápagos land iguanas. The Rosada, whose present distribution is a conundrum, is a relictual lineage with an origin dating to a period when at least some of the present-day islands had not yet formed. So far, this species is the only evidence of ancient diversification along the Galápagos land iguana lineage and documents one of the oldest events of divergence ever recorded in the Galápagos. Conservation efforts are needed to prevent this form from extinction. Imperiled due to devastation of the area's natural flora by invasive goats, the authors have suggested that



the species should be considered “critically endangered” according to IUCN criteria.

### Giant Neotropical Snake and Hotter Equatorial Temperatures

The largest extant snakes live in the tropics of South America and southeastern Asia, where high temperatures facilitate the evolution of large body sizes among air-breathing animals with body temperatures that are dependant on ambient environmental temperatures. We know very little about ancient tropical terrestrial ecosystems, limiting our understanding of the evolution of giant snakes and their relationship to climates in the past. HEAD ET AL. (2009. *Nature* 457:715–718) described a boid snake from the oldest known (58–60 Myr ago) Neotropical rainforest fauna in northeastern Colombia. They estimated a body length of 13 m and a mass of 1,135 kg, making it the largest known snake. The maximum size of poikilothermic animals at a given temperature is limited by metabolic rate, and a snake of this size would require a minimum mean annual temperature of 30–34 °C to survive. That estimate is consistent with hypotheses of hot Palaeocene Neotropics with high concentrations of atmospheric CO<sub>2</sub>. A compar-

ison of palaeotemperature estimates from the equator to those from South American mid-latitudes indicates a relatively steep temperature gradient during the early Palaeogene greenhouse, similar to that of today. Depositional environments and faunal composition are indicative of an anaconda-like ecology for the giant snake.

### New Fossil Reveals How Turtle Got Their Shells

Turtles are unique vertebrates. The distinctive development of a shell, the turtle’s most characteristic feature, is an evolutionary story that has always been a bit of a mystery. Previously, much of what scientists understood about the origin of turtles was derived from fossils of *Proganochelys*, an ancestor from Germany. This specific ancestor had a heavily built shell and spiked plates covering the neck and tail. Researchers suggested that this well-armored creature arose from an extinct line of armored reptiles known as pareiasaurs, and also suggested that the first turtles lived on land, where a shield was a useful defense for a slow-moving animal. However, *Proganochelys* provided no clues to how the turtle shell evolved because its own carapace is fully formed.



An artist's rendition of *Odontochelys semitestacea*.

LI ET AL. (2008. *Nature* 456:497–501) described a fossil in southwestern China’s Guizhou Province that paints a rather different picture of the origin of turtles. This 220-million-year-old fossil reveals a primitive turtle that had only a plastron (the flat, bottom shell that protected the animal’s soft belly). This apparently transitional creature was named *Odontochelys semitestacea*, meaning “half-shelled turtle with teeth.”

*Odontochelys* lacked osteoderms (bony plates in the skin). Some specialists had proposed that these osteoderms had fused gradually over millions of years to form a carapace (the shell covering a turtle’s back), so the apparent lack of osteoderms in *Odontochelys* challenges the belief that turtles were at all closely related to pareiasaurs. This evidence makes a stronger argument that modern-day shelled vertebrates are more likely to be aligned with diapsids, a group of reptilian taxa that includes crocodiles, lizards, snakes, tuataras, and even some birds.

That conclusion has been challenged. Some researchers interpret *Odontochelys* as an early turtle that did in fact have an upper shell, but one that had not fully ossified. This supposition could mean that the unique shell structure of *Odontochelys* was not necessarily a primitive intermediate structure, but rather a specialized adaptation comparable to the soft shell of today’s aquatic turtles. *Odontochelys*, then, may be the signal of an early invasion of water by ancient turtles that had originated on land.

These findings helped place the Thylacine in an improved phylogenetic tree with distantly related, extant marsupials and generated possible markers for geneticists seeking to trace the process of extinction through Thylacine DNA. They also open the door to the feasibility of successful

complete the analysis (MILLER ET AL., *Genome Research*, published in advance, 12 January 2009) came from hairs on a Thylacine skin that had been stored at room temperature for more than 100 years and from a whole tiger preserved in ethanol since 1893.



A 1921 photograph of a Tasmanian Tiger (*Thylacinus cynocephalus*) photographed in a cage with a chicken.

molecular analyses in museum specimens — something Schuster has dubbed “museomics”.

The results also validate ancient DNA sequencing techniques and put the sequencing of the complete Thylacine genome and that of other extinct organisms within reach. “It’s not a question of whether [sequencing the entire Thylacine genome] can be done,” Webb said, “it’s just about coming up with the resources. Any megafauna that went extinct in the last 100,000 years are within reach.”

Bob Grant  
*The Scientist*.com  
12 January 2009

### New Facility Boosts Iguana Conservation Program

The new quarters at the San Diego Zoo’s Wild Animal Park are hot and humid, and that’s just the way its occupants like it. Seventeen iguanas — including three endangered species and a fourth whose population is at risk — are settling into a \$630,000 breeding and research center that opened at the park in the San Pasqual Valley late last month. Named after its primary donors, the 2,000-square-foot Kenneth C. and Anne D. Griffin Reptile Conservation Center is part of a 15-year-old conservation program aimed at boosting endangered iguanas’ numbers in the wild.

The Grand Cayman, Cuban, Jamaican, and Anegada iguanas now at the park formerly lived at the zoo, where researchers studied, bred, and raised them. So far, the 15-year-old iguana program has produced more than 150 young reptiles that were released into their native habitats in the islands for which they are named. The new facility opened on 23 December 2008 in a section of the animal park that is not accessible to the public. Park spokeswoman Yadira Galindo said that conservation pro-

grams are clustered in that area because endangered species need “peace, quiet, and open space” to breed successfully.

Jeff Lemm, a research coordinator for the San Diego Zoo’s Conservation Research Center, said the iguanas’ zoo quarters were supposed to be temporary when the first wild iguana was brought there in 1994. The facility lacked heat and humidity controls, so researchers used heating lamps and other improvised methods to incubate eggs and provide the moist, warm environment in which the reptiles thrive.

Some of the iguana species adapted to the setting and successfully produced offspring, but at least one did not. Lemm said researchers hope to see the egg-laying and birth rate go up in the new facility. Designed to meet their needs, the conservation center has a nursery, kitchen, and large, individual pens equipped with ultraviolet lights, which help iguanas absorb calcium. The 18 x 6’-wide enclosures also have skylights, natural plants, and small doors that can be opened to give the reptiles access to the outdoors or neighboring enclosures. A special air-conditioning system keeps the humidity at the 70–95% range that iguanas like.

Lemm said that the numbers of Grand Cayman Iguanas had dropped to around 12 in the Caribbean before the zoo and several partners started the conservation program in the early 1990s. The Cuban and Anegada iguanas’ populations also were very low, and the Jamaican species was believed to be extinct because of habitat loss and the introduction of non-native predators. “Cats, dogs, and mongooses that people brought in go after iguanas, and hooved animals — cattle, goats, horses, donkeys, sheep, pigs — eat the same plants (as the reptiles) and trample the iguanas.” “Luckily, preserves have been set aside for the Grand Cayman Iguana. A lot of the animals have started breeding



A rare Jamaican Iguana (*Cyclura collei*) in the opening of its shelter at the San Diego Zoo’s Wild Animal Park’s new research facility for iguanas from the West Indies.

again in clutches. So we think we’ve caught it in time.”

Lemm said conservation program participants occasionally exchange iguanas in an effort to ensure the captive population’s genetic characteristics mirror those of wild iguanas on the islands. That way, researchers will be able to reintroduce the reptiles to their original homes if a catastrophic event ever makes that necessary, he said. “Some of those islands are only 2 or 3 inches above sea level, so a catastrophic event could be a hurricane. If a strong enough one comes along, it could wipe out all animal life on the island.”

For more information about the park’s conservation programs, log onto [www.sandiegozoo.org/wap](http://www.sandiegozoo.org/wap).

Andrea Moss  
*North County Times*  
19 January 2009

### Grim News from the Field Museum

The Field Museum is slashing its budget by 15%, thanks to the economic downturn. The venerable Field Museum of Natural History in Chicago is cutting its budget by 15% — laying off staff, paring salaries, and canceling projects — after being hit by the economic recession.

Excerpted from an article by Rex Dalton  
([www.nature.com](http://www.nature.com))



The venerable Field Museum of Natural History in Chicago is cutting its budget by 15% after being hit by the economic recession.

### Copperbelly Water Snake Recovery Plan

The northern population of the Copperbelly Water Snake (*Nerodia erythrogaster neglecta*) is listed by the U.S. Fish and Wildlife Service as a threatened Distinct Population Segment (DPS). The DPS consists of populations north of the 40th Parallel in Indiana, Michigan, and Ohio. Surveys over the last twenty years have documented an ongoing decline in these populations. Many popula-



The discovery of the world’s largest known snake, *Titanoboa cerrejonensis*, suggests that past tropical temperatures were higher than today.

## NEWSBRIEFS

### Sequencing the Extinct

Researchers have sequenced the mitochondrial genome of the extinct Tasmanian Tiger or Thylacine (*Thylacinus cynocephalus*), using museum-preserved tissue samples collected from some of the last remaining individuals. The mitochondrial DNA used to





Many of the northern populations of the Copperbelly Water Snake (*Nerodia erythrogaster neglecta*) are now extirpated, and the five that remain are very small.

tions are now extirpated, and the five that remain are very small. The principal recovery strategy is to establish and conserve multiple wetland/upland habitat complexes that provide adequate habitat for population persistence. Additional efforts also will focus on reducing take due to collection by humans and malicious killing. Outreach materials will be developed regarding the species' presence in the community as part of the natural environment, and to reduce the fear of snakes.

Megan Seymour  
U.S. Fish & Wildlife Service  
Columbus, Ohio

#### Visitors Arrested in the Exuma Cays for Killing Iguanas

The Bahamas National Trust (BNT) announced that two individuals were arrested for a recent incident of taking undersized conch and killing and eating iguanas in the Exuma Cays. Responding to an e-mail distributed by a concerned citizen, the Trust contacted authorities at all levels of government. BNT staff from the Exuma Cays Land & Sea Park and Royal Bahamas Defense Force (RBDF) marines stationed at the park responded by locating the vessel involved in the incident, transporting the local police officials to the vessel, and assisting in the arrest. The individuals have been arrested and are being held pending future court hearings.

Commenting on the situation, Executive Director of the BNT, Mr. Eric Carey, stated that he was "pleased that concerned citizens were able to bring this unfortunate situation to the attention of the Trust. It is unfortunate that a few tourists are able to brazenly violate the natural resources of our country and damage the reputation of the many valued tourists who appreciate and respect our environment. We are pleased

that this matter is now in the hands of the court system and that everyone came together towards a common goal."

The BNT is continuing its efforts to have the others involved in this disgusting incident arrested and brought before the courts. Officials of the Trust expressed appreciation for the assistance and support from the Minister of the Environment in getting this the attention it deserved.

Adapted from *Bahama Islands Info*

Two American tourists have been arrested after photographs of people cooking and eating endangered iguanas in the Exuma Cays were posted on a social networking website. Friends of those responsible for posting the pictures on Facebook circulated the photographs in an e-mail that worked its way to executive director of the BNT, Eric Carey.

Horrified by the gruesome images of the critically endangered species being

butchered, grilled, and devoured, and a dinghy filled with undersized juvenile conch, Mr. Carey alerted staff at the BNT Exuma Cays Land and Sea Park. The park warden and administrator worked with police in George Town and Black Point, Exuma, to track down the suspects.

Two people were arrested in connection with the offense that violates Fisheries Regulations and the Wild Animal Protection Act, prohibiting the possession of dead or live iguanas. Iguanas also are protected under the Convention on International Trade in Endangered Species (CITES) and, as the suspects in custody are understood to be U.S. citizens, Mr. Carey said they could also be charged under U.S. law that makes it illegal to commit an offense in a country that has a relationship with the U.S.

Two other individuals also were featured in photographs showing a group of people taunting, cooking, and eating iguanas, and taking juvenile conch.

Watch the new Tanzania Expedition Movie  
— and much more — at [www.exo-terra.com](http://www.exo-terra.com)

[www.exo-terra.com](http://www.exo-terra.com)



These photographs posted on Facebook showing tourists taunting, cooking, and eating iguanas, and taking juvenile conch led to the arrest of Alexander Daniel Rust of Indiana and Vanessa Starr Palm of Illinois for violating the Fisheries Regulations and the Wild Animal Protection Act.

Mr. Carey said: "We have had people poaching iguanas for the pet trade, but I have never seen this sort of barbaric butchery for consumption by visitors." ... "To see

guys gloating with such disrespect and putting the pictures on such a public profile as Facebook clearly shows they have no fear of prosecution — and we need to prove them wrong. We take the responsibility to enforce wildlife law very seriously."

Adapted from *BahamasB2B.com*

The two American visitors, 24-year-old Alexander Daniel Rust of Indiana and 23-year-old Vanessa Starr Palm of Illinois, arrested after being found in breach of the Fisheries Regulations and the Wild Animal Protection Act were given police bail in the amount of \$500 each.

The two had posted photographs of themselves in the Exuma Cays on a social networking website on the Internet. The series of photographs displayed shows the suspects catching an iguana, parts of an iguana on a grill, two men eating the iguana pieces, and a man and a woman cleaning what appears to be undersized conch. The photos were widely distributed via email to persons around the country by concerned individuals.

Adapted from *The Freeport News*

Alexander Rust received a \$1,000 fine (\$800 for removing undersized conch and \$200 for killing an endangered species). Vanessa Palm received only a warning. This event may trigger changes in proscribed fines (current amounts date to implementation of the Wild Animals Protection Act in 1968).

#### Court Order Forced the State to List the Endangered California Tiger Salamander

The California Fish and Game Commission last week formally designated the California Tiger Salamander (*Ambystoma californiense*) as a candidate for threatened or endangered status under the California Endangered Species Act, extending legal protections to the species for one year while a status review is conducted. The Commission was forced by a Center for Biological Diversity petition and lawsuit, and a recent court of appeals ruling, to make the designation.

"Despite the Fish and Game Commission's misguided attempts to repeatedly deny protected status to the California Tiger Salamander, the candidate designation sets the listing process back on the right track and should ultimately result in the Tiger Salamander getting the state-protected status it deserves," said Jeff Miller, a conservation advocate with the Center for Biological



California Tiger Salamanders (*Ambystoma californiense*) are candidates for state threatened or endangered status. This individual was being released to augment a natural population.

Diversity. "Every expert biologist who studies the California Tiger Salamander has weighed in and recommended the species be listed."

The Center for Biological Diversity petitioned the Commission in 2004 to list the California Tiger Salamander as endangered due to the impacts of urban and agricultural development. The Santa Barbara County salamander population has been listed as endangered under the federal Endangered Species Act since 2000, as has the Sonoma County population since 2003. The central California population has been federally listed as threatened since 2004.

The Commission rejected the petition in 2004, falsely claiming it did not contain all of the data necessary to prove the salamander population deserved protection. The Center filed suit, and the Commission was forced by court order and a state appeals court ruling in September 2008 to accept the petition. The state Supreme Court refused to review the appeals court ruling. The Commission last week voted 3–2 for candidacy, clearly reluctant to protect the species. One Commissioner repeatedly referred to the presence of California Tiger Salamanders on private land as a "salamander problem" and referred to the court that issued the petition acceptance order as "jerks" and "stupid."

State candidate species are afforded many of the legal protections of endangered or threatened species while a year-long status review is conducted. A final state listing determination for the California Tiger Salamander is due in February 2010.

The court decision on the California Tiger Salamander has potential implications for other poorly monitored species, since the court ruled that the Commission must consider a listing petition if the information would "lead a reasonable person to conclude there is a substantial possibility" that the species could be listed.



The California Tiger Salamander depends on ephemeral vernal pools for breeding. In recent decades, 95% of California's vernal pools have been lost, and at least 75% of the salamander's habitat throughout the state has been eliminated. In Sonoma County, 95% of the fragmented and minimal remaining salamander habitat is threatened by development; the Santa Barbara population also is on the verge of extinction. The Sonoma population survives in only seven viable breeding sites and the Santa Barbara population consists of only six breeding groups.



A Grand Cayman Racer (*Cubophis caymanus*) swallowing a Common Iguana (*Iguana iguana*), which is an invasive species on Grand Cayman.



Southeast Asian Box Turtles (*Cuora amboinensis*) are disappearing from parts of Indonesia, where they once were common.

Jeff Miller  
Center for Biological Diversity

**Native Snake Snacks  
on Alien Iguana**

Golfers were not expecting to see a snake eating an iguana on the 5th hole of the Britannia golf course, but James Robinson and two friends came across this snake, an indigenous Grand Cayman Racer (*Cubophis caymanus*), swallowing a Common Iguana or Green Iguana (*Iguana iguana*), which is an invasive species.

Robinson said they were just walking onto the green when they saw the snake. "At first my mates didn't believe me. We watched it for maybe 5 minutes and then finished the hole and then came back again. To start, it just had the head, and then when we left it had got past the iguana's legs. Then the snake dragged it off into the bushes."

Local naturalist Fred Burton identified the snake from Robinson's photograph and noted that the Cayman Racer is a rear-fanged snake, capable of envenomating a young iguana, so the iguana was probably comatose by the time the photo was taken. He also indicated that snakes need about five days to digest a big frog before they want another meal, so this particular diner was probably set for a while.

Cayman News Service  
23 February 2009

**Unregulated trade in  
Southeast Asian Box Turtles**

Unregulated trade — at 10–100 times legal levels — has caused Southeast Asian Box Turtles (*Cuora amboinensis*) almost to vanish from parts of Indonesia, where they once were common. The species is one of 29 native freshwater turtles in Indonesia. It has a low reproductive rate, making it susceptible to over-harvesting. The turtles are used for meat

and in traditional Chinese medicine, with major markets in Hong Kong, China, Singapore, and Malaysia, mostly supplied from Indonesia. Animals also are exported as pets, mainly to the U.S., Europe, and Japan.

The study by TRAFFIC, the wildlife trade monitoring network, found at least 18 traders operating in Java, Sulawesi, Sumatra, and Kalimantan dealing illegally in Southeast Asian Box Turtles. Each trader handled an average of just under 2,230 turtles a week, a combined total of 2.1 million turtles per year. The vast majority is destined for export, although Indonesia's official annual export quota for this species is just 18,000 turtles, a figure set without a scientific basis.

"The number of Southeast Asian Box Turtles currently traded is certainly ten times the official export quota, and probably nearer 100 times it," said Dr. Sabine Schoppe, author of the report. Thirteen of the 18 traders investigated were registered for some trade in reptiles (but not in box turtles) with the provincial offices of the government's Directorate General of Forest Protection and Nature Conservation (PHKA), which is required to inspect such businesses regularly.

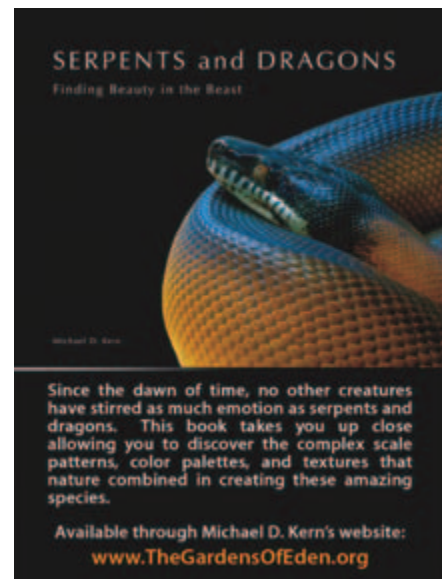
Collectors in Riau and Sulawesi reported huge falls in Southeast Asian Box Turtle numbers in the wild, and registered pet traders said they had experienced difficulties in obtaining turtles compared to a decade ago. "The current level of illegal exploitation will result in Southeast Asian Box Turtles being systematically wiped out across Indonesia, indications of which are already obvious at collection and trade centers," said Schoppe.

"The Southeast Asian Box Turtle has historically been considered common, but is currently listed as "Vulnerable" on the IUCN Red List of Threatened Species," said Dr. Anders Rhodin, Chair of the IUCN

Tortoise and Freshwater Turtle Specialist Group. "If present trends of massive over-harvesting and unsustainable illegal trade continue, this formerly common species will soon be "Critically Endangered," and could follow the Passenger Pigeon into the annals of conservation failures. We cannot afford to lose any more of these animals. We need to stamp out illegal trade in this and all other overexploited species before it's too late."

"Authorities should concentrate on eradicating illegal trade, and in setting realistic limits on what numbers can be harvested safely," said Chris R. Shepherd, Senior Programme Officer with TRAFFIC Southeast Asia. Weak enforcement of existing laws is a key problem, caused through a combination of factors including non-inspection of shipments, falsification of CITES export permits, and lack of training among enforcement officers.

IUCN  
23 February 2009



**IRCF**

**Editors**

- Robert Powell  
Executive Editor  
Avila University, Kansas City, MO
- AJ Gutman  
Editor  
Bloomfield, CT
- Gad Perry  
Associate Editor  
Texas Tech University, Lubbock, TX
- Jackie Forbus  
Assistant Editor  
Texas Tech University, Lubbock, TX
- Michael Ripca  
Art Director  
Atco, NJ
- John Binns  
Graphics/Photography  
International Reptile Conservation  
Foundation, San Jose, CA
- Sandy Binns  
Services Coordinator  
International Reptile Conservation  
Foundation, San Jose, CA

**Editorial Board**

- Allison C. Alberts  
Zoological Society of San Diego
- Frederic J. Burton  
Blue Iguana Recovery Program
- Arthur C. Echernacht  
University of Tennessee
- L. Lee Grismer  
La Sierra University
- Robert W. Henderson  
Milwaukee Public Museum
- John B. Iverson  
Earlham College
- Charles R. Knapp  
Zoological Society of San Diego
- Gunther Köhler  
Senckenberg Museum
- Kenneth L. Krysko  
Florida State Museum of  
Natural History
- Jan Ramer  
Indianapolis Zoo
- Thomas Wiewandt  
Wild Horizons

**Editor's Remarks**

We've had a very busy and exciting few months watching this new incarnation of the journal take shape — and we hope you like what you see. Our new title, after much consideration, has become *Reptiles & Amphibians: Conservation and Natural History*, a name we hope balances description with aesthetic presentation. The biggest and most obvious change on the inside is the use of color throughout, and, given the magnificent variety of our subject matter, the results are sure to please. Imagine our delight at being able to present the newly discovered pink Galapagos Land Iguana in its proper hues! Particular acknowledgements need to go to team members John Binns, Michael Ripca, and Robert Powell for their countless hours and many sleepless nights in bringing our new look to fruition.

AJ Gutman, Editor

**STATEMENT OF PURPOSE**

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

The International Reptile Conservation Foundation, Inc. is a non-profit 501 (c)(3) California corporation.

**MEMBERSHIP INFORMATION**

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

Annual Rates:

- Individual U.S. Membership . . . . . \$25.00
- Individual Membership, Digital (Adobe PDF)\* . . . . . \$25.00
- Institutional U.S. Subscription . . . . . \$30.00
- International Membership (including Canada) . . . . . \$55.00
- International Institutional Subscription . . . . . \$60.00

Additional copies are available upon request at \$6.00 each plus postage.

\*The Adobe PDF is optimized for web publishing and does not provide the quality and resolution of the archival printed version, especially noticeable in photographs and complex graphics.

JOIN ONLINE: [www.IRCF.org](http://www.IRCF.org)

**MEMBERSHIP QUESTIONS**

info@IRCF.org, or Toll free 1-877-472-3674 (U.S. Only), or write to: IRCF, 3010 Magnum Drive, San Jose, CA 95135

**SOLICITATIONS**

The IRCF encourages contribution of articles, letters to the Editor, news items, and announcements for publication in *REPTILES & AMPHIBIANS*. General articles can deal with any aspect of reptilian or amphibian 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.

**DONATIONS**

For any donations, please include your name, address, phone number, and e-mail address.

**ADVERTISING POLICY**

We advertise only non-living products (except feeder insects). For advertising rates and options contact Sandy Binns, Advertising Director, at SB@IRCF.org or 3010 Magnum Drive, San Jose, CA 95135.



## Spot-tailed Earless Lizards — A Vanishing Species



R. WAYNE VAN DEVENGER

The Spot-tailed Earless Lizard (*Holbrookia lacerata*) appears to have been extirpated from many of its historical locations in central and southern Texas and adjacent areas in northern Mexico. Although the species does not currently appear on any state or federal threatened or endangered lists, its conservation status is uncertain. Mike Duran, a zoologist with The Nature Conservancy of Texas (TNCT) believes that a species disappearing from its historic range is indicative of an environmental problem, probably pesticides in this case. “If pesticide use is so devastating that it’s wiping out an entire species, that’s something at which we need to take a closer look.”

These lizards are about 6 in long and covered with spots on the back and tail. The name, however, refers to spots underneath the tail, which are lacking in related “earless” species (so called because they lack external ear openings). Habitat appears to consist of areas that are sparsely vegetated with some bare ground, on a variety of soil types, but never on pure sand. These include upland savannas, plowed fields in places that originally were grasslands, thinly vegetated Mesquite shrublands, semi-xeric mesquite, Prickly Pear brushlands, and coastal prairie.

In order to determine the current distribution and develop a habitat model for the species, TNCT is beginning range-wide surveys at 207 sites in March–June 2009, months when these lizards are most active, and is seeking volunteers and information. The surveys are being undertaken with the help of a grant from the Texas Parks and Wildlife Department’s Horned Lizard License Plate Fund and in cooperation with Ralph Axtell and a number of Texas herpetologists and universities.

If you would like to volunteer to assist in surveys, or if you have information about *Holbrookia lacerata* that may not currently be included in the historical record, contact Mike Duran at [mduran@tnc.org](mailto:mduran@tnc.org) or visit [www.nature.org/wherewework/northamerica/states/texas/features/art27236.html](http://www.nature.org/wherewework/northamerica/states/texas/features/art27236.html) for more information about the project.



ROBERT POWELL

Puerto Rican Groundsnakes or Small Racers (*Arrhyton exiguum*) are uncommon and secretive on Guana Island in the British Virgin Islands. However, at the Sage Mountain Reserve on nearby Tortola, the highest and wettest spot in the Virgin Islands, these snakes are much more frequently encountered, suggesting that the dry conditions on Guana may limit activity and numbers. See article on p. 6.



