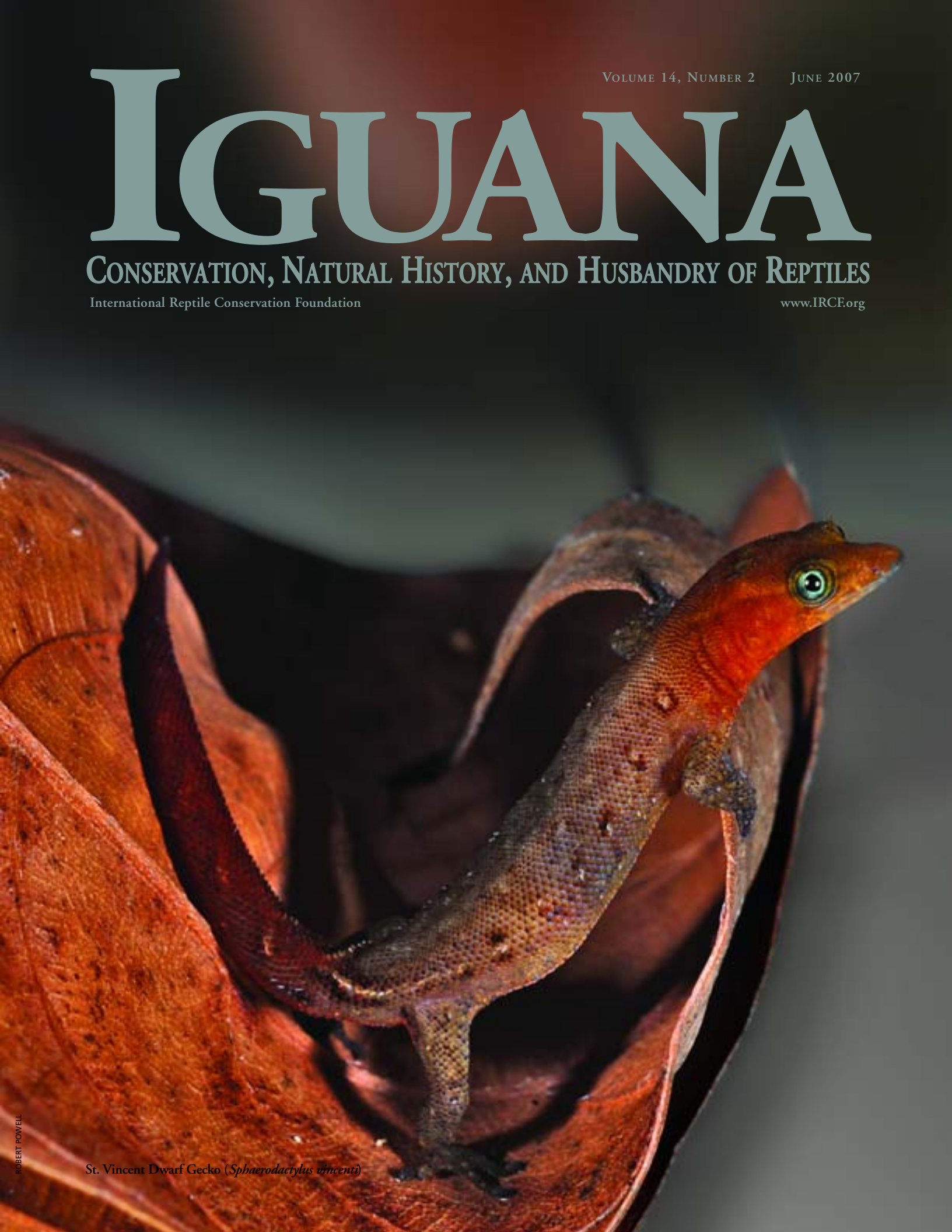
Volume 14, Number 2 June 2007

IGUANA

Conservation, Natural History, and Husbandry of Reptiles

International Reptile Conservation Foundation www.IRCF.org



ROBERT POWELL

St. Vincent Dwarf Gecko (*Sphaerodactylus vincenti*)

FEDERICO KACOLIRIS

The survival of Sand Dune Lizards (*Liolaemus multimaculatus*) in Argentina is threatened by alterations to the habitats for which they are uniquely adapted (see article on p. 66).

ARI R. FLAGLE

Boelen's Python (*Morelia boeleni*) was described only 50 years ago, testament to its remote distribution nestled deep in the mountains of Papua Indonesia (see article on p. 86).

ALI REZA

Dark Leaf Litter Frogs (*Leptobrachium smithii*) from Bangladesh have very distinctive red eyes (see travelogue on p. 108).

LUTZ DIRKSEN

Although any use of Green Anacondas (*Eunectes murinus*) is prohibited by Venezuelan law, illegal harvests are common (see article on p. 74).

GARY S. CASPER

Butler's Garter Snake (*Thamnophis butleri*) was listed as a Threatened Species in Wisconsin in 1997. An effort to remove these snakes from the Wisconsin list of threatened wildlife has been thwarted for the moment (see article on p. 94).

CHARLES H. SMITH, U.S. FISH & WILDLIFE SERVICE

The Golden Toad (*Bufo periglenes*) of Central America was discovered in 1966. From April to July 1987, over 1,500 adult toads were seen. Only ten or eleven toads were seen in 1988, and none have been seen since 15 May 1989 (see Commentary on p. 122).

ROBERT POWELL

About the Cover

Diminutive geckos (< 1 g) in the genus *Sphaerodactylus* are widely distributed and represented by over 80 species in the West Indies. *Sphaerodactylus vincenti* is a relatively large sphaerodactyl, reaching a maximum snout-vent length of 40 mm. The *S. vincenti* complex includes nine currently recognized subspecies, which occur on the St. Lucia, Dominica, Martinique, and St. Vincent island banks. These lizards can be found in leaf litter, under rocks and rotten logs, and in bromeliads. On St. Vincent, *S. v. vincenti* reaches high densities (to 5,625 lizards/ha) in moist, shaded leaf-litter. Such microhabitats provide refuges, access to prey, and protection against desiccation, to which these tiny lizards are exceedingly vulnerable. Geckos living in moist environments at higher elevations are larger and less resistant to water loss than geckos occupying drier habitats at lower elevations. *Sphaerodactylus vincenti* appears to be a dietary generalist that feeds on a variety of small arthropods primarily by day. See also the Natural History Research Report on p. 132.

IRCF
International Reptile Conservation Foundation

TABLE OF CONTENTS

JOHN BINNS

Critically endangered *Ctenosaura melanosterna* is known only from the Rio Aguan Valley in northern Honduras and Cayos Cochinos off the Caribbean coast of Honduras. Extent of occurrence and area of occupancy are both estimated at less than 100 km^2. The total population size is not known, but is thought to be fewer than 2,500 mature individuals. The population is severely fragmented, with an estimated 10–15 isolated subpopulations. Main threats to the species are habitat loss and collecting for the international pet trade. A future population decline of at least 30% is probable if current rates of habitat loss continue.

Sand Dune Lizards (*Liolaemus multimaculatus*) are extremely cryptic. Surveys consist of multiple researchers walking transects across the dunes while counting the fleeting glimpses of lizards as they scurry away.

Natural History and Conservation of the Sand Dune Lizard (*Liolaemus multimaculatus*)

Federico Kacoliris

Sección Herpetología, Departamento de Vertebrados
Museo de La Plata, Buenos Aires, Argentina
(fedekacoliris@yahoo.com.ar)

Photographs by the author.

The day is dawning on the beaches of Buenos Aires. The sun's first rays caress the sand. As the temperature starts to rise, so too do the small inhabitants of this landscape. The Sand Dune Lizard (*Liolaemus multimaculatus*) starts its daily activities at a sluggish pace that will quicken with the warming rays of the sun.

This small saurian, a typical representative of these immense sand fields, has evolved for so many centuries in such close association with the landscape that it is unable to survive elsewhere. Its current conservation status is critical, primarily due to the irrational and excessive exploitation of these environments. Thus, this Argentinean endemic lizard is now categorized as a vulnerable species.

An overview of the dynamics of this ecosystem, as well as of its former and present use, is essential in understanding both the life history of this species and its current situation.

What is the Value of Coastal Areas?

Coastal environments represent about 8% of the Earth's surface, and they are considered among the most threatened environments on the planet. Most human-generated threats to biodiversity are exacerbated in these areas, mainly because human populations have always flourished along shorelines. Over half the world's population (about 3.2 billion people) live within 200 km of oceans and seas (only 10% of the earth's land surface). With this population distribution, increasing human numbers and mounting developmental pressures are taking a grim toll on coastal and near-shore resources. Sand dunes act as filters for water that allow the existence of aquifers (underground reservoirs of drinking water that supply nearby localities) and protect the coastline from erosion, ensuring the long-lasting existence of sandy beaches. In addition, coastal areas are attractive and offer great potential for tourism.

The marine coastal zone of Buenos Aires Province is particularly diverse in natural environments, including sandy beaches, cliffs, extensive sand dunes, and a large brackish lagoon (Mar Chiquita). These diverse ecosystems support numerous native plant and animal species that are threatened to varying degrees. Several of these species are poorly known, and some are in danger of extinction, as is the case with the Sand Dune Lizard.

From a historical perspective, urban development along the coast of Buenos Aires, which has been the most popular tourist destination in the country for about a century, has not involved adequate planning or resource management. Urban planning has not taken into account the risks of erosion when designing roads or drainages, or the impact of sand extraction on the sediment transport cycle. Furthermore, the current environmental impact legislation does not consider climate change, an extremely relevant factor in these highly dynamic systems. Other factors, such as pollution, overexploitation of resources (both fisheries and sand), use of 4 x 4 vehicles on the beaches and dunes, and the introduction of exotic plants for dune fixation,

JOHN BINNS

The Mar Chiquita Provincial Park lies along the Argentinian Atlantic coast

Sand Dune Lizards (*Liolaemus multimaculatus*) have evolved in such close association with these sandy habitats that they cannot exist elsewhere.

Sand Dune Lizards, such as this adult female, are small saurians, less than 70 mm from snout to vent, with a flattened body and a stout head.

represent additional disturbances. These problems seriously affect biological and geological aspects of the coastal fringe by altering its natural dynamics, modifying the landscape, and threatening the natural, paleontological, historical, and cultural heritage of the community.

The populations of endemic fauna and flora, that is, those species that evolved in and can only survive in coastal habitats, are the most affected by these activities, and they could be wiped off the face of the Earth within a few years. The Sand Dune lizard is one of these species, and its populations are already severely compromised.

Sand Dune Lizards

Five species of lizards occur in the coastal sand dunes in Buenos Aires province and the northern coastal region of Río Negro

Small size, body form, and color are all adaptations for life in the sandy dunes.

Juvenile Sand Dune Lizards may be distinguished from adults by the yellow lateral bands that disappear at maturity.

Endangered coastal dunes in Argentina act as filters for water that allow the existence of aquifers and protect the coastline from erosion, ensuring the long-lasting existence of sandy beaches.

province, Argentina. These are *Liolaemus multimaculatus*, *L. wiegmanni*, *L. gracilis*, *L. darwinii*, and *Stenocercus pectinatus*. All but *L. darwinii* are known as sand-dwelling lizards due to their preference for sandy biotopes. In addition, *L. multimaculatus* and *L. wiegmanni* are highly specialized for life in the sand, and are accordingly clustered in a monophyletic assemblage of "sand-dwelling lizards" within the genus *Liolaemus*. However, only the populations of *L. multimaculatus* occur exclusively in these habitats, whereas the other four species have wider geographic dis-

Six isolated patches of coastal dunes remain in Buenos Aires Province; all have been declared "Áreas Valiosas de Pastizal" (Valuable Grassland Areas). These patches are separated from each other by coastal towns catering to tourists, which block gene flow between lizard populations in each area.

The author and Ricardo Cañete, a park ranger at the Mar Chiquita Natural Reserve. Rangers monitor and enforce protective measures intended to preserve some of the few remaining natural areas. They also are providing logistical help with this study.

Males are larger than females and have scattered ventral spots that are not visible in this view.

tributions. Historically, this species could be found throughout the marine coast of Buenos Aires; now, however, it has become hard to find in areas where it used to be abundant. Its habitat specializations make this lizard an "indicator species." Indicator species reflect the "health" of the ecosystems they inhabit and are the first to disappear when faced with serious alterations of their habitats.

Liolaemus multimaculatus is a small saurian, less than 70 mm long from snout to vent, with a flattened body and stout head. Its dorsal coloration shows a somewhat irregular pattern of dark spots in transverse series on a brownish background. The spots are outlined posteriorly by white scales, which give them a sand-like appearance. These lizards show evident sexual dimorphism in size and ventral coloration (males are larger and have scattered ventral spots). They usually are seen on dunes with low or sparse plant cover as they scurry away; when not in motion, the lizards are virtually undetectable; their coloration and texture are a perfect match for the substrate. To burrow and "sand-swim," these lizards require loose sandy substrate, which does not occur in areas with abundant vegetation, such as the those planted with exotic species such as pines (*Pinus* sp.), acacias (*Acacia* sp.), or Tamarisk (*Tamarix* sp.).

What is Happening to the Sand Dune Lizard?

This species is highly adapted to life in the sand. Its sand-swimming ability and cryptic coloration attest to the close evolutionary ties between this lizard and the coastal dunes. Its situation is even more critical given the severe alterations experienced by the coastal habitats in Buenos Aires Province, because it cannot colonize and survive in other habitat types. Studies carried out in a dune sector called "Mar del Sur" have shown that this species is highly sensitive to habitat alteration; minor disturbances such as the establishment of a trail for 4 x 4 vehicles can seriously affect its natural populations, causing a critical drop in population density and eventually leading to localized extirpation. This situation is clearly evident in the dune sector situated between the

"Sand-swimming" involves axial oscillations of the trunk and tail, and can be performed only in substrates that are too loose to permit tunnel formation, which is not the case in areas with abundant vegetation, such as those planted with exotic species.

Spots are outlined posteriorly by white scales, giving these lizards a sand-like appearance and rendering them extremely cryptic.

towns of Villa Gesell and Cariló, where this lizard was abundant no more than 10 years ago; today it is practically impossible to find in that area.

Only six patches of coastal dunes remain in Buenos Aires Province, and they have been declared "Áreas Valiosas de Pastizal" (Valuable Grassland Areas) for South America. These patches are isolated and separated from each other by coastal towns catering to tourists, thus making it impossible for the lizard populations in each of them to interbreed. This factor prevents gene flow, thus reducing the genetic and phenotypic plasticity that allows greater flexibility in responding to abrupt environmental changes. In addition, these patches (with the exception of small portions that have been preserved as natural reserves) are not managed with a focus on the conservation of the habitats and species that live in them. On the contrary, the excessive and irrational exploitation that takes place in these areas disregards any environmental protection, and ultimately facilitates the disappearance of the original environment along with its native flora and fauna, including the Sand Dune Lizard.

Studying and Conserving the Sand Dune Lizard

In 2004, as part of a Ph.D. research program, a study of the population dynamics of this lizard was initiated under the direction of Jorge Williams (La Plata University). Due to its restricted distribution in dune islands, as well as its high degree of specialization for this particular type of environment, this species is an excellent model organism for basic ecological studies. Later, after considering the problems that affect this species, the project was expanded to include new aspects related to the protection of its relictual populations. The main goals of this project are: (1) Locating, assessing, and monitoring the status of wild populations, and (2) providing the general public with clear information about its circumstances, and taking action to promote conservation strategies for this species in particular and the sand dunes in general. This is accomplished by means of two interrelated programs.

Even when their approximate location is known, finding and catching these lizards is difficult.

Gala Sanchez Velíz, an advanced biology student at La Plata University, measures a lizard.

The Scientific Research Program

The goal of this program is the study of basic aspects of population dynamics (spatial arrangement, population density, survival, and mortality), autoecology (habitat use, home range), and elements that allow us to assess the status of wild populations, such as the study of fluctuating asymmetry (a bioindicator of environmental stress that is expressed in populations subject to primarily anthropic impacts producing size differences between left and right body sides) and any decreases in genetic variability due to population isolation. Knowledge of the basic ecology of a species is essential for establishing management guidelines and initiating conservation action. The study is intended to encompass all of the coastal dunes that remain in Buenos Aires Province. However, due to the lack of effective and sustained financial support, the project has been restricted largely to research in specific sectors, mainly the natural reserves at Mar Chiquita and Faro Querandí and neighboring areas. The results of these studies will permit the identification of priority areas for monitoring and conserving wild *L. multimaculatus* populations, as well as for ongoing assessments of their conservation status. To optimize fieldwork, volunteers from around the world have been solicited to help with this project. Thus, a relatively large group of people are available during the most intense stages of the project (e.g., during the reproductive season in spring and summer, when these lizards are most active, given that they hibernate and are inactive during the winter. Volunteers perform different research-related tasks, and some also participate in activities that promote public awareness.

Volunteers from around the world have helped with this project. The 2007 Sand Dune Lizard work group in the field (from left to right): Gala Sanchez Velíz (La Plata University), the author, Gianluca Guaitoli (an Italian naturalist), Alberto Rafael (La Plata University), Cristiano Liuzzi (an Italian wildlife technician), and Alejandro Molinari (La Plata University).

Once in hand, individuals are measured and marked prior to release at the original site of capture.

Blood samples are taken for genetic studies that will allow researchers to assess the effects of isolation on individual populations. The author (right) is assisted by volunteers: Javier Caimi (center) and Paula Lourenco are biology students at La Plata University.

Public Awareness Program

The goal of this program is to provide clear and understandable information about the severe threats affecting the Sand Dune Lizard and the coastal dunes. Results of the research program are conveyed to the local community in an effort to create a greater awareness about these issues. Using a conservationist approach, we emphasize information about the benefits of conserving the coastal natural resources. This program is part of a larger team effort, the "Coastal Conservation Workgroup" ("Grupo de Trabajo para la Conservación de las Costas" or GTCC) integrating researchers from the Universidad Nacional de la Plata, Universidad de Buenos Aires, and Fundación de Historia Natural "Félix de Azara," all of whom share a mutual interest in the conservation of coastal environments. To achieve the project's stated goals, conferences are organized and brochures and posters are distributed in several coastal towns. Results of this work also have been presented at meetings and in scientific journals in Argentina and internationally.

Information about preservation efforts is diseminated in public education programs and at scientific meetings; here, the author (right) and Cintia Celsi present a poster at a meeting of the Grupo de Trabajo para la Conservación de las Costas (GTCC = Coastal Conservation Workgroup).

What Can We Do?

Gaining knowledge is the first stage of a process that can lead to a greater awareness of the difficulties faced by this species in particular and its environment in general. The second stage is the initiation of definitive actions that promote rational and sustainable use of these habitats at personal, institutional, and governmental levels. These natural habitats can be enjoyed without altering them or affecting the plants and animals that have coexisted for such a long time. These goals can be realized if humans become aware of the current situation and sensitive to other realities beyond our own. The preservation of the natural world is our responsibility.

The coast grows dark, and as the sun moves into the sea to hide beyond the horizon, a lizard burrows in the sand under a large tussock where it has chosen to spend the night, escaping the cold and nocturnal predators. The Sand Dune Lizard rests from its forays, recovering its energy for what we hope will be many new tomorrows.

Acknowledgements

The International Reptile Conservation Foundation (IRCF) and the Neotropical Grassland Conservancy (NGC) supported fieldwork in 2007.

References

Bilenca, D.N. and F.O. Miñarro. 2004. *Identificación de áreas valiosas de pastizal (AVP's) en las pampas y campos de Argentina, Uruguay y sur de Brasil.* Fundación Vida Silvestre Argentina, Buenos Aires.

Hinrichsen, D. 2004. Ocean planet in decline. People & the Planet 2000–2007 (www.peopleandplanet.net/doc.php?id=429&section=6).

Kacoliris, F., N. Horlent, and J. Williams. 2006. Herpetofauna, coastal dunes, Buenos Aires Province, Argentina. *Check List* 2(3) (www.checklist.org.br/getpdf?SL010-06).

Vega, L., P. Bellagamba, and L. Fitzgerald. 2000. Long-term effects of anthropogenic habitat disturbance on a lizard assemblage inhabiting coastal dunes of Argentina. *Canadian Journal of Zoology* 78: 1-8.

LUTZ DIRKSEN

Green Anacondas (*Eunectes murinus*) are the most widely distributed species of anacondas. Although some pythons may attain greater lengths, no other snake is as massive. These snakes are found in most tropical lowland habitats east of the Andes. Although any use of the Green Anaconda is prohibited by Venezuelan law, illegal harvests are common. Between 1988 and 1990, international authorities confiscated 2,138 anaconda skins in Holland that supposedly originated in Venezuela.

Conservation of Green Anacondas: How Tylenol Conservation and Macroeconomics Threaten the Survival of the World's Largest Snake

Jesus A. Rivas

Department of Mathematics and Natural Sciences, Somerset Community College, Somerset, Kentucky

Many biologists consider economics and politics to be bad words. Because we are not trained in their use and implications, we often prefer to avoid issues that involve those topics. Consequently, when we discuss the economics of conservation, we usually talk about economic incentives for conservation and sustainable use of natural resources, but often fail to delve more deeply. We identify the cost of a commodity from nature, what its exploitation represents from an environmental perspective, and what economic incentives might filter down to the populace, but we almost always lose sight of the larger macroeconomic framework in which such discussion belongs. For this reason, the solutions we offer often fail to address the real economic needs of both natural and human communities, and our proposed solutions frequently are vulnerable to fiscal and political pressures that fail to consider that the environment is more than a source of commodities. Herein, I will discuss the macroeconomic situation in Latin America and the impact that politics and economic policies have had on conservation, and specifically how these affect anacondas and related conservation issues in South America.

TONY CROCCETTA

Capturing Green Anacondas can be difficult. Although snakes are large and can inflict painful bites, they move slowly compared to many smaller snakes, and can be handled safely by experienced personnel.

The Problem of Conservation

Visitors to rural areas of Latin America have enjoyed beautiful landscapes and pristine natural ecosystems alongside the less-pleasurable experiences of seeing how the local people live. Their economic limitations and struggles make it immediately clear that no amount of education or enforcement of regulations can (and should?) prevent them from using natural resources for their own survival (McSweeney 2005). People living in a money-driven system with few means of obtaining money are easily persuaded to exploit nature in an unsustainable fashion. The sale of wildlife is a common example (e.g., Fitzgerald et al. 1991, Robinson and Redford 1991, Vickers 1991). Whether they use nature unsustainably of their own accord, due to lack of education and environmental awareness, or are encouraged (or forced) by external commercial interests (e.g., Camhi 1995), abject poverty is the primary problem and no conservation program can succeed without addressing it.

Neoliberal Economic Policies

For the last half century, international economic agencies (IEAs), such as the World Bank (WB), the International Monetary Fund (IMF), and the United States Agency for International Development (USAID), have been actively promoting development by injecting money into the national economies of underdeveloped nations. The idea is to stimulate those economies, eventually providing countries with the means to pay back the money received (e.g., World-Bank 2001, Kütting 2004, Clapp and Dauvergne 2005). However, reality differs; nations that have received the most economic "help" have experienced dramatic increases in poverty (e.g., Buhdoo 1994, Rich 1994, Jochnick 2001, Navarro-Jimenez 2004). The problem seems to be that help comes with strings attached. These "strings," called structural adjustment programs (SAPs), may include decreasing or eliminating internal subsidies for agriculture, dropping trade barriers, allowing international companies to operate in the

CAROL FOSTER

Capable of taking large prey, Green Anacondas, nevertheless, are often injured during the struggle. This snake is ingesting a Capybara (*Hydrochaeris hydrochaeris*), which inflicted the bite responsible for the large wound.

WILLIAM HOLSTROM

During the breeding season, as many as 13 male Green Anacondas have been observed competing to mate with a single female, with the mating aggregation lasting as long as four weeks. Here, eight males court a female in Venezuela. Females may mate with more than one male during the breeding season.

WILLIAM HOLSTROM

Green Anacondas are ambush predators on aquatic prey or animals that come to the water to drink. This adult female (SVL 363 cm, 40 kg) regurgitated a 10-kg White-tailed Deer (*Odocoileus virginianus*) shortly after capture.

country, granting exceptions to environmental regulations, eliminating social benefits, and relaxing labor laws.

Also, money must often be used to hire specific transnational companies. Such entities are known as export credit agencies (ECAs) and often are associated with the government of a developed country. Consequently, much of any loan never reaches the country it is supposed to benefit, moving instead from one bank account to another in a developed nation (e.g., Goldzimer 2003, Perkins 2004, Clapp and Dauvergne 2005). ECAs hire employees at minimum wage, but since SAPs impose lower wages and drop social assistance and workers' benefits, the minimum wage does not really address poverty. People have jobs, but the costs of essential commodities (produce, water, housing) have gone up because the workers are now part of a global market. Consequently, the local standard of living drops (e.g., Horta 1991, Cheru 1992, Yunus 1994).

Such a neoliberal agenda can lead to environmental degradation. People use resources in an unsustainable manner and companies dump pollutants (in part due to the lowering of environmental standards originally intended to spur economic growth). Both result in habitat deterioration (e.g., Horta 1991, Cheru 1992, Rich 1994, Pearce et al. 1995, Horta et al. 2002). Especially when companies are temporary, like those involving mining or logging, departure leaves behind pollution, destroyed habitat, unemployment, and even more poverty than existed previously (e.g., Goldzimer, 2003). One example is Argentina, which embraced a neoliberal agenda wholeheartedly during the late 1990s. In 2002, the bubble burst, leaving the country in great poverty (Blustein, 2005). The crash of the Argentinean economy was followed by political upheaval and economic and social turmoil. Such social unrest has caused a series of uprisings in South America, toppling presidents in Argentina (2002), Bolivia (2003, 2005), and Ecuador (1997, 2000, 2005). Needless to say, during times of economic and political upheaval, conservation takes a back seat.

Economy and the Environment

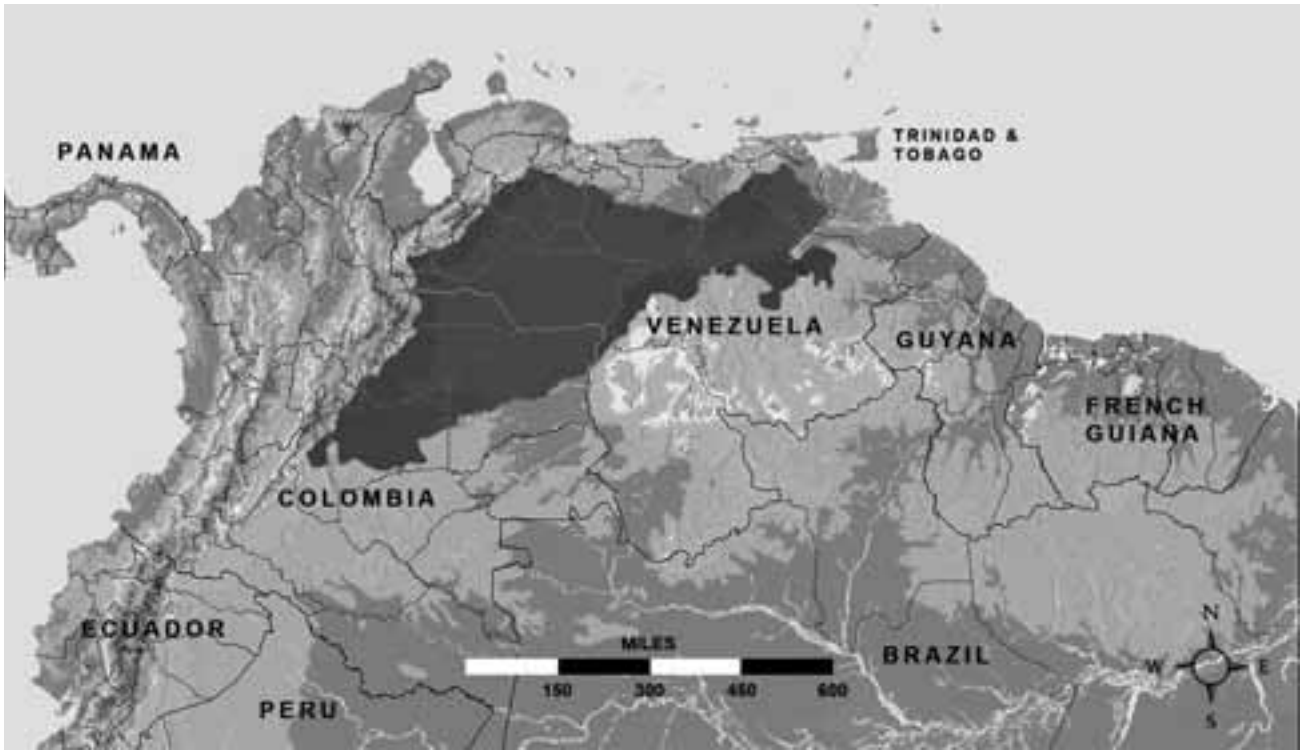
The sustainable use of natural resources has been offered as one potential solution to economic problems, with the rational use of wildlife as an alternative to destruction of natural habitats. Sustained harvest of wild populations has been implemented in several countries for subsistence (Robinson and Redford 1991, Shaw 1991, Silva and Strahl 1991, Vickers 1991, Balick and Mendelson 1992, Bodmer et al. 1997) and commercial purposes such as hides, meat, or live pets (Fitzgerald et al. 1991, Groom et al. 1991, Beissinger and Bucher 1992, Joanen et al. 1997). For example, several endangered crocodilians are recovering in response to effective harvesting practices (see Thorbjarnarson et al., 1992 for a review).

Wildlife Management and Conservation in Venezuela

Venezuela has withstood the economic crisis better than other Latin-American countries, primarily due to the country's oil reserves. However, from 1982 to 1998, the economy slowly but consistently declined. As the economy of the country deteriorated and wages fell, people were forced to rely on unconventional resources. For instance, in the past, traditional consumption of Capybara (*Hydrochaeris hydrochaeris*) meat was restricted to the week before Easter. More recently, illegal hunting of Capybaras extended throughout the year, as people resorted to Capybara meat as a staple. Traditionally, most of the country's meat came from Rancho El Frío. For more than 30 years, El Frío had sustained an estimated population of roughly 30,000

TONY GROCCETTA

This carcass of a Green Anaconda was found on the parched savanna. Snakes moving in the dry season searching for water occasionally fail to find a cool refuge during the heat of the day.



The Venezuelan llanos (= flatlands) are characterized by vast grasslands with ribbons of forest along creeks and rivers. It is an environment of harsh extremes, severe droughts alternating with floods. The llanos are sparsely populated by humans, with most inhabitants engaged in raising cattle. The llanos are Venezuela's greatest repository of wildlife.

Capybaras, of which about 10,000 were harvested annually (Ojasti, 1991). In 1986, I participated in a survey of El Frío Capybaras that recorded a population of only slightly above 4,000 animals. Later surveys showed an additional decrease in the population, with poaching acknowledged as the leading cause of the population crash. This trend is, not surprisingly, expected to continue and extend to other species as poverty in the country becomes increasingly prevalent.

Pressures on Anaconda Populations

Although any use of the Green Anaconda (*Eunectes murinus*) is prohibited by Venezuelan law, illegal harvests are common. Between 1988 and 1990, international authorities confiscated 2,138 anaconda skins in Holland that supposedly originated in Venezuela (Profauna archives). Among the confiscated hides were skins of *E. murinus*, which occurs in Venezuela, and of Yellow Anacondas (*E. notaeus*), which occur only in southern South America. When I and my collaborators started studying anacondas in 1992 (Rivas et al. 2007), I learned that tanneries were paying the equivalent of U.S. $16.67 per meter of skin. This is a significant amount for a worker whose income otherwise averages about $3.50 a day.

Legal low-profile anaconda harvests occur in several South American nations. In Guyana, anacondas are harvested opportunistically by fishermen and sold to local tanners (Mirna Quero, pers. comm.). Yellow Anacondas have been harvested legally in Argentina (Waller et al., 2007) and illegally in Paraguay (P. Micucci, pers. comm.). Bolivia had initiated studies investigating the sustainable use of *E. murinus*, but political unrest halted the development of the program (J. Aparicio, pers. comm.).

Farming versus Harvesting Anacondas

The most common methods of extractive wildlife management are farming, harvesting, or some combination of both. In a farming model, animals are kept in captivity, a relatively expensive proposition, but practical for animals with fast growth rates, low maintenance expenses, and capable of being held in high densities. Traditional farming of Green Anacondas is not practical. The cost of facilities and maintenance would be prohibitively high. Also, anacondas take several years to reach adulthood, and females breed only every other year at best (Rivas, 2000).

However, an "open farm system" may be possible. Large pregnant females can be found along the riverbanks (Rivas 2000, Rivas et al. 2007b), caught, kept in captivity, and released after they deliver. Due to high fertility (Rivas, 2000), a large number of individuals can be produced quickly. Neonates have a high natural mortality in the field (Rivas 2000, Rivas et al. 1999, 2001, 2007b). Releasing some percentage of individuals subjected to lower captive mortality rates would presumably equal the number that would have survived to that age in nature. Neonates can grow quickly (Holmstrom 1982, Rivas et al. 2007b), and, after a relatively short period in captivity, could provide scar-free, small-scaled skins with high value on the legal market.

Anacondas do not make good pets. They quickly outgrow cages, and become a risk to other pets and even people. They

have an aggressive temperament and never become an easy (or safe) animal to handle. They also release a fetid musk when disturbed. Nevertheless, anacondas remain popular and potentially profitable (approximately $250/neonate, retail). The illegal import of live reptiles for the pet trade continues to grow (Hoover 1998). This market is hard to control, and the number of animals being extracted from nature is difficult to quantify. A legal source of neonates from a sustainable system could serve to protect the wild population.

Closed-system farming would benefit only the few people working on the farm, and does not require pristine habitat. Consequently, farming has at best a modest impact on the local economy (Thorbjarnarson 1999). So, although sustainable, farming would not be a constructive conservation method, but merely business as usual, differing only in the use of a wildlife commodity. A system of open farming, involving the capture and post-parturition release of adult females, on the other hand, has potential as a conservation tool because it requires a pristine environment where the animals live.

In contrast, in a cropping system, animals are harvested from the wild; thus a direct link exists between the economic activity and the conservation of the species and its habitats. Economic incentives are directly linked to habitat preservation, and thus cropping has real potential for use as a conservation tool. Harvesting is best suited for animals that occur in high densities and are easy to find and catch. Overhead is much lower than for farming, since the only investment involves finding and catching animals (product storage and transport to market is an inevitable component of either method). However, harvesting has a much greater potential for detrimental effects on natural populations. Monitoring and controlling the harvest are high priorities that can be very expensive and potentially troublesome.

Estimating Numbers

Before attempting the management of any species, we must understand its basic life history. Even modest success at wildlife management depends upon some knowledge of demography, especially abundance, rate of increase, fecundity, mortality, recruitment, and dispersal. Estimates of population size and the intrinsic rate of increase are necessary in order to calculate the maximum sustainable yield (MSY; the maximum number of individuals that can be removed from a population while maintaining population size).

TONY RATTIN

This female Green Anaconda (410 cm SVL, 44 kg) is being courted by 12 males.

Because anacondas are secretive, we cannot accurately determine the total number of animals in any area. An alternative is to estimate the population size using an index of relative abundance (e.g., number of snakes seen per km of road). This way we can propose a conservative MSY, refine it by monitoring the impact of harvesting with repeated surveys, detecting any problems, and adjusting the take in a timely fashion (Caughley, 1977; Caughley and Sinclair, 1994). To date, however, we lack any estimate of anaconda abundance, which would require long-term mark and recapture studies, nor do we have any index of relative abundance — and none of the traditional methods are easily applied. One possibility would be to count sightings of pregnant females along riverbanks or edges of roads, where they frequently bask. In the interim, the lack of a field-based method for monitoring the impact of a cropping program, commercially exploiting anacondas could result in over-harvesting.

Capturing animals presents another challenge. Looking for anacondas is probably not cost-effective in light of the low frequency of capture that I have encountered (Rivas et al. 2007b). One option would be to combine harvests of anacondas with that of other potentially valuable species such as Spectacled Caimans (*Caiman crocodilus*), turtles (*Podocnemis* spp), Common Iguanas (*Iguana iguana*), and Common Tegus (*Tupinambis teguixin*) (Thorbjarnarson and Velasco 1999). All of these reptiles occur in relatively high densities and are potentially manageable. However, implementation of a sustainable management plan for any or all of these species requires basic knowledge about their populations in any given area — knowledge that is currently lacking.

Hunters typically target the largest individuals (males in many exploited species), because they provide more skin or meat. In polygynous species (in which a male mates with more than one female in a single breeding season), this is potentially sustainable, since most matings are by only a few males, leaving a theoretical surplus available for harvesting. Anacondas, however, are polyandrous (in which a female mates with more than one male in a single breeding season; Rivas 2000, Rivas and Burghardt 2001, Rivas et al. 2007a, 2007b) and females are larger. Also, the largest females contribute the most offspring (females >340 cm are responsible for nearly 60% of new offspring every year, and females >300 cm contribute nearly 75% of each new generation; Rivas, 2000). In other words, harvesting practices biased for large females would dramatically and quickly impact population numbers.

Harvesting males would seem to be a feasible alternative. They are easier to find, can be gathered in greater numbers in breeding aggregations, and have skins with fewer scars because they are smaller in size and feed on less dangerous prey (Rivas 2000, Rivas and Burghardt 2001, Rivas et al. 2007b). However, females that are courted by several males have higher reproductive success (Rivas, 2000), so the quota of males would have to be assessed very carefully, and hunters may not accurately discriminate males from females.

Sustained commercial use of large snakes appears to work in Sumatra, where Reticulated Pythons (*Python reticulatus*), Blood Pythons (*Python brongersmai*), and Short-tailed Pythons

(*Python curtus*) are harvested serendipitously near plantations and villages (Shine et al., 1999). This method targets mostly males due to their higher mobility, and produces a variable rate of harvest that changes with snake abundance. Because hunters are not targeting snakes, this method of hunting has the potential to be self-regulating. A drop in the population will produce a lower encounter rate that will result in a lower harvest. A similar method is used for Green Anacondas in Guyana, where fishermen gather snakes opportunistically. Like the python harvest, this method seems to be sustainable, although quantitative data are lacking. However, increases in poverty levels of rural inhabitants can dramatically increase the levels of harvesting.

Management of Anacondas

Anacondas and other boids are listed in CITES Appendix II, which requires permits be obtained for any commercial trade. In Venezuela, anacondas remain abundant due to large expanses of relatively undisturbed wetland habitats (Rivas et al. 2002). No legal commercial trade exists, and the illegal market for skins places little pressure on populations at the moment. Although edible, anacondas are not eaten. Other than the skin, the only product of value is the fat. Melted anaconda fat is considered a medicine for throat problems, asthma, and other respiratory ailments. However, the demand is low and localized. Because selling anaconda products is illegal, few campesinos engage in harvests. Instead, the main reason that local people kill anacondas is because they fear and dislike them. Arguments that anacondas eat poultry, livestock, pets, or even people are often used to justify killing snakes.

Habitat degradation in the llanos has not yet been a serious problem, since most land use for cattle involves increasing the area covered by water for longer periods (Rivas et al. 2002). The impact of extensive cattle ranching on wildlife here is much lower than the impact in the United States or other countries where cattle are kept at higher densities. However, old-fashioned ranching practices involve cutting forests to ease handling of livestock (that often hides in the forest and becomes feral) and allow easy access to water in dry season. Federal laws prohibit deforestation within 50 m of a river, but this regulation is seldom enforced. Deforestation increased dramatically in the late 1990s. Riverbanks often develop "caves" that are supported by tree roots, and these caves are frequently used as refugia by anacondas. In the treeless savanna, anacondas have fewer places to hide and escape from extreme drought. This can be important in atypical years during which anacondas may be exposed to extreme heat (Rivas 2000, Rivas et al. 2007b). Caves along segments of rivers without forest are less abundant and smaller than those in other areas because the lack of roots allows erosion. Cutting the forest is a direct threat to anacondas, in addition to the effects of deforestation on populations of prey species and other components of forest ecosystems.

Management as a means of incorporating use of anacondas into economic development plans is difficult, and more research is needed. Harvesting males, as well as farming of neonates, are

TONY CROCCETTA

Much of the Venezuelan llanos is managed for cattle, with dikes used to hold water for the dry season. Consequently, encounters between cowboys and snakes occur frequently.

Spectacled Caimans in Venezuela

In 1986, the Venezuelan government initiated the harvest of Spectacled Caimans (*Caiman crocodilus*). This program operates on private lands, where owners hire a biologist to survey the population, and, based on the estimate of population size, Profauna licenses a given quota. Owners hire people to harvest and process the animals. Skins are bought by tanners that prepare the skins to crosta (one step of the tanning process) and sell them to overseas companies that manufacture the final products. This program provides some benefits to landowners, to local workers, to biologists who conduct surveys, and to tanners who process and export skins. Relying on a prolific species of high commercial value that is relatively easy to count and harvest (Thorbjarnarson and Velasco 1999), the program would appear to be a perfect example of conservation management.

Regardless of potential and good intentions, the program has been engaged in a battle of wits with poachers who took advantage of loopholes in the regulations. Once the word got out that a square foot of caiman skin was worth $40, no safe havens remained for the animals. Every effort to tweak legislation was matched and overmatched immediately by new means of circumventing the law. Landowners would kill and market caimans from surrounding areas to keep their own populations high in future surveys. Efforts to count skulls and carcasses and match them with the number of skins were implemented to ensure that caimans were killed where permits allowed (carcasses are too heavy to carry on burros, causing poachers to retrieve only skins). This immediately spawned a new breed of entrepreneur, whose business consisted of renting truckloads of rotting carcasses to crooked landowners. This is only one example of the many tricks that Profauna had to uncover in their effort to implement the program. Many of the people who were supposed to be involved in the management of a sustainable resource never perceived it as anything other than an ephemeral source of wealth. Consequently, this resulted in dramatic population declines in many areas (Thorbjarnarson and Velasco 1999). This program was unsuccessful not only because it failed to convince locals that it was a long-term program capable of providing sustained revenues, it also failed to provide adequate economic incentives to the local populace, who never saw the need to protect the resource.

F. WAYNE KING

In 1986, the Venezuelan government initiated the harvest of Spectacled Caimans (*Caiman crocodilus*) on private lands. Photograph copyright © 1996 Florida Museum of Natural History, used with permission (http://www.flmnh.ufl.edu/natsci/herpetology/CROCS/Crocpics.htm).

possible alternatives that can be explored. However, both practices involve many logistical problems in addition to ethical issues that cannot be ignored. Killing animals for human comfort and leisure is an ongoing theme of heated debates between those concerned with animal welfare and those who manage wildlife for profit (Robinson 1993, Joanen et al. 1997, Struhsaker 1998, McLarney 1999, Medellin 1999). New regulations adopted by the international community regarding import of exotic wildlife, in the name of conservation or animal welfare, can limit the market and jeopardize investments made by producers. Importing live animals raises ethical issues regarding the welfare of pets that might end up in the hands of novice pet owners who do not maintain animals in optimal conditions. In the case of larger reptiles, an additional problem arises when an animal reaches a size at which it is difficult to keep. Frequently, animals are released in exotic environments where they usually die of exposure or starvation. If they survive and reproduce, further problems arise as a consequence of exotic invaders in foreign ecosystems (Atkinson 1989, Snow et al. 2007). For instance, Green Anacondas have been found in the Florida Everglades (Snow et al. 2007), although evidence of reproduction is lacking.

Many countries have resorted to exploiting wildlife to solve economic crises. In Venezuela, recommendations resulting from my research have largely stemmed plans to commercially harvest anacondas, but less out of concern for the resource than because the abundance of oil has relieved part of the pressure on the economy. At the moment, anacondas are at little risk of being harvested in Venezuela. However, poverty in rural areas throughout South America, increased human encroachment, and political and economic turmoil continue to threaten the species, and these threats are expected to increase.

I suggest that the least difficult and controversial benefit to local communities vis-à-vis anacondas is the lure that a "charismatic mega-fauna" provides for ecotourism. The llanos has a tremendous and unrealized potential for ecotourism due to the large abundance and diversity of wildlife, which is comparable to that of the Amazonian rainforest (Rodríguez and Rojas-Suarez 1996). However, in the vast savannas of the llanos, animals are readily spotted and appreciated. Reinvesting profits generated by ecotourism in the local community in terms of jobs, education, and welfare are vital if ecotourism is to succeed as a conservation tool.

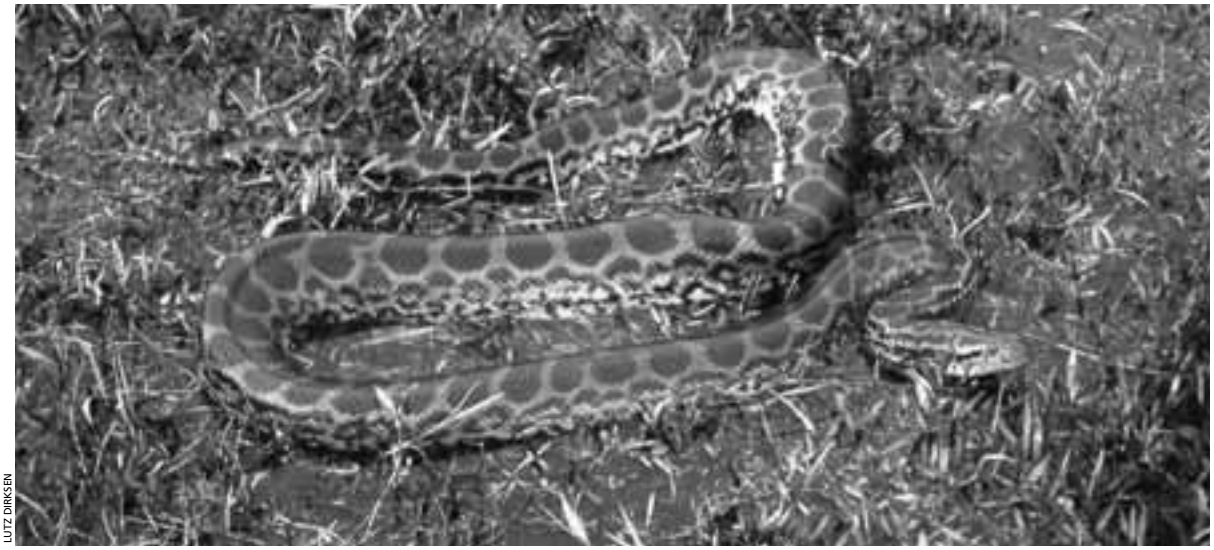
Yellow Anacondas in Argentina[1]

An experimental harvest of Yellow Anacondas (*Eunectes notaeus*) has been implemented in Formosa Province, Argentina. The program encouraged indigenous peoples and rural mestizos to catch snakes over 2.3 m in length that were found opportunistically during the months of August–October, the beginning of the warm season. The 2.3-m length was determined by the fact that skins of that size were 23 cm wide, the minimum necessary for making purses without patching pieces together. Locals were paid 15–20 pesos (= ~$4–5.40), depending on the size of animals. No quotas or restrictions on where animals were caught were imposed. The economic benefits can represent an important part of the locals' annual budget in an area where farmers live on incomes of about $150/year. However, the people who took the lion's share of proceeds were higher in the economic chain. Skins were sold to shoe- and purse-making factories at $50 per meter. So, a snake that was, for example, 3 m in length, was bought for $4 by the tanner and then sold for $150 to make purses worth several hundred dollars. If local people had benefited adequately, they would have become guardians and active stewards of the land. Instead, the program was less of an effort to manage anacondas than an economic enterprise using anacondas as a capital commodity.

To place this program into economic and political contexts, we have to realize that the country's neoliberal constitution (1994) established autonomy for the provinces over their natural resources, which took the decision-making away from the central government. Consequently, for example, if an association of tanners proposed a program to the central government offering to inject $100K into the economy, it would not be nearly as tempting for the nation's government as it would be for that of a small province. By allocating the decision-making to smaller authorities, persuasion of those authorities by offers that might not be in the best interests of the country or the environment is much easier.

Yellow Anacondas are smaller than Green Anacondas, but share a female-biased sexual size dimorphism. Because 2.3 m in length is about the upper limit on the size of males, this harvesting plan pretty much guarantees the exclusive harvesting of females. Furthermore, animals are found primarily by searching for individuals basking on dense vegetation, and the only snakes that regularly bask are pregnant females (Rivas, 2000). Conversations with local harvesters indicated that they anticipated a sharp decline in anacondas due to the large number of females harvested.

[1] **Editor's note:** An Argentinian NGO (Fundación Biodiversidad) developed and proposed this plan to the National Government in 2001. It later became the first experimental approach (possibly worldwide) for the adaptive management of a boid that has been hunted historically and massively regardless of any law or biological consideration. The Program (which generates skins for international trade) deals with a CITES Appendix II species, requiring its management to comply with Article IV (non-detrimental finding) of the Treaty. The Fundación Biodiversidad must provide annual reports to the National Government (CITES Authority) in order to renew export authorizations and comply with CITES requirements. The program is monitored closely, which allows detection and correction of any problems that might arise. Waller et al. (2007) noted that: "For the first time in more than 20 years, biologists were able to design and test a harvest methodology for this traditionally exploited species. The experimental harvest began in 2002, and approximately 5,000 skins of an average length of 2.6 m were obtained in Formosa each year between 2002 and 2004, following strict administrative and technical procedures (Micucci et al., 2006)." An article describing the plan in detail will appear in the next issue of *IGUANA*.



LUTZ DIRKSEN

An experimental harvest of Yellow Anacondas (*Eunectes notaeus*) has been implemented in Formosa Province, Argentina.

Management versus Conservation

Conservation and use of wildlife are not detached from other economic and political issues, and we cannot address the former without considering the latter. Common tendencies are to use the natural resources for profit without an environmental agenda by exploiting opportunities and funds provided by conservation. Such an approach is not sustainable, although it appears to use natural resources in a "green" manner. In fact, such activities may harm conservation efforts. The use and depletion of natural resources in the name of conservation give it a negative image, which, in turn, drains funds and distracts attention from real solutions.

Business or Conservation?

When management is used for conservation, the economic incentives are tools for encouraging local people to protect the environment. The purpose of assigning an economic value to a resource is to provide stewards of the land reasons for protecting it. The alternative is exploiting the environment for commercial gain. The latter, however, may involve businesses that use resources in a sustainable manner and are environmentally friendly or businesses that loot the environment for short-term profit. While sustainable use is a legitimate practice, it differs from conservation measures in that the priority is maximizing gains.

Impact of Neoliberalism on Conservation

Despite evident declines in Venezuelan caiman populations (see Box) (Thorbjarnarson and Velasco, 1999), Profauna chose to ignore repeated warnings of over-exploitation from the scientific community, probably because the agency depended on the revenues generated by sales of caiman skins. A program is inherently flawed when the people who administer a resource are dependent on the exploitation of that resource. This is an example of a larger problem. In the late 1980s, Venezuela was heavily influenced by a neoliberal agenda (Larrea, 2004). Recommended measures for economic development (SAPs) demanded that the government did not sponsor research or any other activities that were not linked to administration of resources; instead, self-financing became the mantra of the relevant governmental agencies. The laws of supply-and-demand should rule the system (Navarro-Jimenez 2004). However, because managers had to compromise their own jobs if they took any action to stop the program, they did not respond to evidence of declines. In fact, when the program slowed solely due to the increasingly low density of caimans, Profauna underwent major structural changes, downsized, and eventually disappeared.

The Argentinean program for harvesting Yellow Anacondas (see Box) also embraced a neoliberal agenda. During the late 1990s, economic growth had slowed and the nation was facing serious economic problems. By the end of 2001, the IMF pulled out and the economy crashed (Blustein 2005), rendering imperative the exploitation of a natural resource. Tanners in Formosa Province provided a fund of $100,000 for harvesting anacondas, a juicy contribution to a stagnant economy. The whole system depended on the urgent need to produce cash to ameliorate the economic crises. Turning down a business opportunity was not an option.

NATIONAL GEOGRAPHIC, USED WITH PERMISSION

Bundling Green Anaconda skins for transport to the tanning plants.

The Fallacy of Tylenol Conservation

Choosing to ignore or deny the impact of macroeconomics on conservation will not lead to a solution. We cannot address the problems of conservation unless we acknowledge the root cause. Ignoring the big problems by trying to address those that are easier or cheaper to solve is the fallacy of "Tylenol Conservation." Taking a painkiller rather than addressing the underlying problem often results in the need for more and stronger painkillers as time passes. A similar approach in conservation creates an illusion that we are working to make a difference while distracting us from addressing the real issues.

Another example of Tylenol conservation is the tendency to identify and protect areas of high diversity, when the real solution is addressing threats to the land. Protective legislation is, like a painkiller, a handy tool, but not a solution to the problem. In Latin America, extreme poverty is the underlying cause of conservation problems. Protecting a piece of land, education, and providing some economic relief for locals through wildlife management or ecotourism are laudatory, but are only painkillers that provide, at best, only temporary relief.

The main point with which I want to leave the reader is that conservationists must realize that politics and macroeconomics are not dirty words, but simply disciplines in which we need to be involved. If we really want to make a difference in conservation, we need to attack the roots of problems and causes — and the origins of conservation problems are rarely biological. Instead, economic, social, and political issues are often responsible. Integrating concerns about environmental degradation and loss of biodiversity with support of movements for sustainable economies and perhaps even anti-neoliberal globalization movements can result in more effective solutions with better chances for long-term successes.

Acknowledgements

I thanks Sarah Corey and William Hayes for relevant comments on earlier versions of this article. I also thank COVEGAN and Estacion Biológica Hato El Frío for logistical support and assistance during fieldwork.

Literature Cited

Atkinson, I. 1989. Introduced animals and extinctions. In: D. Western and M. Pearl (eds.), *Conservation Biology for the Twenty-First Century*. Oxford University Press, New York.

Balick, M.J. and R. Mendelson. 1992. Assessing the economic value of traditional medicines from tropical rainforests. *Conservation Biology* 6:128–129.

Beissinger, S.R. and E.H. Bucher. 1992. Sustainable harvesting of parrots for conservation, pp. 73–115. In: S.R. Beissinger and N.F. Snyder (eds.), *New World Parrots in Crisis*. Smithsonian Institution Press, Washington, D.C.

Blustein, P. 2005. *And the Money Kept Rolling In (and Out): Wall Street, the IMF and the Bankrupting of Argentina*. Public Affairs, New York.

Bodmer, R.A., J.A. Penn, P. Puertas, L. Moya, and T.G. Fang. 1997. Linking conservation and local people through sustainable use of natural resources: Community-based management in the Peruvian Amazon, pp. 315–358. In: C.H. e. Freese (ed.), *Harvesting Wild Species: Implications for Biodiversity Conservation*. John Hopkins University Press, Baltimore, Maryland.

Buhdoo, D. 1994. IMF/World Bank wreak havoc on the Third World, pp. 20–23. In: K. Danaher (ed.), *50 Years Enough: The Case Against the World Bank and the International Monetary Fund*. South End Press, Boston, Massachusetts.

Camhi, M. 1995. Industrial fisheries threaten ecological integrity of the Galapagos Islands. *Conservation Biology* 9:715–719.

Caughley, G. 1977. *Analysis of Vertebrate Populations*. John Wiley and Sons, New York.

Caughley, G. and A.R. Sinclair. 1994. *Wildlife Ecology and Management*. Blackwell Scientific Publications, Oxford.

Cheru, F. 1992. 1992 Structural adjustment, primary source trade and sustainable development in Sub-Saharan Africa. *World Development* 20:497–512.

Clapp, J. 2001. *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries*. Cornell University Press, Ithaca, New York.

Clapp, J. and P. Dauvergne. 2005. *Path to a Green World*. The MIT Press, Cambridge, Massachusetts.

Fitzgerald, L.A., J.M. Chani, and O.E. Donadio. 1991. *Tupinambis* lizards in Argentina: Implementing management of a traditionally exploited resource, pp. 303–316. In: J.G. Robinson and K.H. Redfort (eds.), *Neotropical Wildlife Use and Conservation*. Chicago University Press, Chicago, Illinois.

Goldzimer, A. 2003. Worse than the World Bank? Export Credit Agencies, the secret engine of globalization. *Food First Backgrounder* 9(1).

Groom, M.J., R.D. Podolsky, and C.A. Munn. 1991. Tourism as a sustained use of wildlife: A case study of Madre de Dios Southern Perú, pp. 393–412. In: J.G. Robinson and K.H. Redford (eds.), *Neotropical Wildlife Use and Conservation*. Chicago University Press, Chicago, Illinois.

Holmstrom, W.F. 1982. *Eunectes* (anacondas): maturation. *Herpetological Review* 13:126.

Hoover, C. 1998. The US role in the international live reptiles trade: Amazon tree boas to Zululand dwarf chameleons. TRAFFIC North America, Washington, D.C. (http://www.traffic.org/reptiles/).

Horta, K. 1991. Multilateral development institutions bear major responsibility on solving Africa's environmental problems, pp. 21–28. In: P. LeBel (ed.), *Environmental Policies for Sustainable Growth in Africa. Proceedings of the Fifth International Conference*. Montclair State University, Upper Montelair, New Jersey.

Horta, K., R. Round, and Z. Young. 2002. The global environmental facilities: The first ten years — growing pains or inherent flaws?, p. 36. In: *Environmental Defense and Halifax, NS*. The Halifax Initiative, Washington, D.C.

Joanen, T., L. McNease, R.M. Elsey, and M.A. Staton. 1997. The commercial consumptive use of the American Alligator (*Alligator mississippiensis*) in Louisiana: Its effect in conservation, pp. 465–506. In: C.H. e. Freese (ed.), *Harvesting Wild Species: Implications for Biodiversity Conservation*. John Hopkins University Press, Baltimore, Maryland.

Jochnick, C. 2001. Perilous prosperity. In: New Internationalist 335 (http://www.thirdworldtraveler.com/South_America/Perilous_Prosper_Ecuador.html).

Kütting, G. 2004. *Globalization and the Environment*. State University of New York Press, Albany.

Larrea, M. 2004. El referendo y la descolonización de Venezuela. In: Red Voltaire (http://www.voltairenet.org/article122533.html?var_recherche=Larrea?var_recherche=Larrea).

McLarney, W.O. 1999. Sustainable development: A necessary means for effective biological conservation. *Conservation Biology* 13:4.

McSweeney, K. 2005. Indigenous population growth in the lowland Neotropics: Social science insights from biodiversity conservation. *Conservation Biology* 19:1375–1384.

Medellin, R.A. 1999. Sustainable harvest for conservation. *Conservation Biology* 13:225–227.

Micucci, P.A., T. Waller, and E. Alvarenga. 2006. Programa Curiyú. Para la conservación y aprovechamiento sustentable de la Boa Curiyú (*Eunectes notaeus*) en la Argentina. Etapa experimental piloto 2002–2004, Formosa, pp. 77–92 In: M.L. Bolkovic and D. Ramadori (eds.), *Manejo de Fauna Silvestre en la Argentina. Programas de Uso Sustentable*. Dirección de Fauna Silvestre, Secretaría de Ambiente y Desarrollo Sustentable, Buenos Aires, Argentina.

Navarro-Jimenez, G. 2004. *Geopolítica Imperialista. De la Doctrina de los dos Hemisferios a la Doctrina Imperial de George W. Bush*. Ediciones Zitra, Quito.

Ojasti, J. 1991. Human exploitation of capybaras, pp. 236–252. In: J.G. Robinson and K.H. Redford (eds.), *Tropical Wildlife Use and Conservation*. University of Chicago Press, Chicago, Illinois.

Pearce, D., N. Adger, D. Maddison, and D. Moran. 1995. Debt and the environment. *Scientific American* 272:52–56.

Perkins, J. 2004. *Confessions of an Economic Hit Man*. Berret-Koehler Publisher Inc., San Francisco.

Rich, B. 1994. *Mortgaging the Earth: The World Bank, Environmental Impoverishment and the Crisis of Development*. Earthscan, London.

Rivas, J.A. 2000. Life history of the Green Anaconda with emphasis on its reproductive biology, p. 364. In: *Ecology and Evolutionary Biology*. University of Tennessee, Knoxville.

Rivas, J.A. and G.M. Burghardt. 2001. Sexual size dimorphism in snakes: Wearing the snake's shoes. *Animal Behaviour* 62:F1–F6.

Rivas, J.A., M. d. C. Muñoz, G.M. Burghardt, and J.B. Thorbjarnarson. 2007a. Mating system and sexual size dimorphism of the Green Anaconda (*Eunectes murinus*). *In:* R.W. Henderson and R. Powell (eds.), *Biology of the Boas and Pythons*. Eagle Mountain Publishing Company, Eagle Mountain, Utah.

Rivas, J.A., M. d. C. Muñoz, J.B. Thorbjarnarson, G.M. Burghardt, W. Holmstrom, and P. Calle. 2007b. Natural history of the Green Anaconda (*Eunectes murinus*) in the Venezuelan llanos. In: R.W. Henderson and R. Powell (eds.), *Biology of the Boas and Pythons*. Eagle Mountain Publishing Company, Eagle Mountain, Utah.

Rivas, J.A., R.Y. Owens, and P.P. Calle. 2001. *Eunectes murinus*: Juvenile predation. *Herpetological Review* 32:107–108.

Rivas, J.A., J.V. Rodriguez, and C.G. Mittermeier. 2002. The llanos, pp. 265–273. In: R. Mittermeier (ed.), *Wilderness*. Cemex, México.

Rivas, J.A., J.B. Thorbjarnarson, R.Y. Owens, and M. d. C. Muñoz. 1999. *Eunectes murinus*: Caiman predation. *Herpetological Review* 30:101.

Robinson, J.G. 1993. The limits of caring: Sustainable living and the loss of biodiversity. *Conservation Biology* 7:20–28.

Robinson, J.G. and K.H. Redford (eds.). 1991. *Neotropical Wildlife Use and Conservation*. University of Chicago Press, Chicago, Illinois.

Rodríguez, J.P. and F. Rojas-Suarez. 1996. Guidelines for the design of conservation strategies for the animals of Venezuela. *Conservation Biology* 10:1245–1252.

Shaw, J.H. 1991. The outlook for sustainable harvest of wildlife in Latin America, pp. 24–36. In: J.G. Robinson and K.H. Redford (eds.), *Tropical Wildlife Use and Conservation*. University of Chicago Press, Chicago, Illinois.

Shine, R.G., Ambariyanto, P.S. Harlow, and Mumpuni. 1999. Reticulated Python in Sumatra: Biology, harvesting and sustainability. *Biological Conservation* 87:349–357.

Silva, J.L. and S.D. Strahl. 1991. Subsistence hunting, pp. 37–52. In: J.G. Robinson and K.H. Redford (eds.), *Tropical Wildlife Use and Conservation*. University of Chicago Press, Chicago, Illinois.

Snow, R.W., K.L. Krysko, K.M. Enge, L. Oberhofer, A. Warren-Bradley, and L. Wilkins. 2007. Introduced populations of *Boa constrictor* (Boidae) and *Python molurus bivittatus* (Pythonidae) in southern Florida. In: R.W.

Henderson and R. Powell (eds.), *Biology of the Boas and Pythons*. Eagle Mountain Publishing Company, Eagle Mountain, Utah.

Struhsaker, T.T. 1998. A biologist's perspective in the role of sustainable harvest in conservation. *Conservation Biology* 12:930–932.

Thorbjarnarson, J.B. 1999. Crocodile tears and skins: International trade, economic constraints and limits to sustainable use of crocodilians. *Conservation Biology* 13:465–470.

Thorbjarnarson, J.B., H. Messel, F.W. King, and J.P. Ross. 1992. *Crocodiles, An Action Plan for Their Conservation*. IUCN, Gland, Switzerland.

Thorbjarnarson, J.B. and A. Velasco. 1999. Economic incentives for management of Venezuelan caiman. *Conservation Biology* 13:397–406.

Vickers, W.T. 1991. Hunting yields and game composition over ten years in an Amazon Indian territory, pp. 53–81. In: J.G. Robinson and K.H. Redford (eds.), *Tropical Wildlife Use and Conservation*. University of Chicago Press, Chicago, Illinois.

Waller, T., P.A. Micucci, M. Mendez, and E. Alvarenga. 2007. The management and conservation biology of Yellow Anacondas (*Eunectes notaeus*) in Argentina. In: R.W. Henderson and R. Powell (eds.), *Biology of the Boas and Pythons*. Eagle Mountain Publishing Company, Eagle Mountain, Utah.

World Bank. 1992. *World Development Report*. Oxford University Press, New York.

World Bank. 2001. Adjustment lending retrospective: Final report operation policies and country services. World Bank, Washington, D.C. (http://siteresources.worldbank.org/Projects/Resources/ALR06_20_01.pdf).

Yunus, M. 1994. Preface: Redefining development, pp. ix–xii. In: K. Danaher (ed.), *50 Years Enough: The Case Against the World Bank and the International Monetary Fund*. South End Press, Boston, Massachusetts.

SPECIES PROFILE

Amazon Treeboa (*Corallus hortulanus*)

Robert W. Henderson

Milwaukee Public Museum

The most geographically and ecologically widespread of the eight currently recognized species of the Neotropical treeboa genus *Corallus, C. hortulanus* ranges from Amazonian Colombia and Venezuela, through the Guianas, throughout Amazonian Brazil, Ecuador, Peru, and Bolivia, and south into Brazil's Atlantic Forest to about 26º 08' south latitude, and on Ilha Grande (off southeastern Brazil). It occurs in diverse habitats, including primary and secondary rainforest, mixed forest, second growth, palm forests, swamp forest, cerrado, caatinga (where it is probably confined to gallery forests), and savanna/grassland with stands of trees. It is often associated with edge situations and may be especially common in trees at the margins of bodies of water (rivers, lagoons, lakes). It also exploits heavily disturbed situations, such as fruit orchards (bananas, cacao), and will enter human edifices (outbuildings, homes), likely seeking shade, a diurnal retreat, or a human commensal rodent. Altitudinal distribution is from sea level to about 915 m, although it is uncommon above 300 m.

Few snake species worldwide can compete with *Corallus hortulanus* when it comes to variation in color and pattern. Dorsal ground color of the boas may be various shades of yellow, orange, gray, taupe, and/or brown. They may be virtually patternless yellow or orange, or have an ellipse-like shape that may be a shade of the ground color or in sharp contrast to it, or it may appear extremely mottled (but close inspection usually reveals the ellipse shape).

Amazon Treeboas are nocturnal and, as the name implies, largely arboreal. Their bodies are laterally compressed, and snakes may attain snout-vent lengths (SVL) over 1.6 m, and can reach SVLs of 1.8–1.9 m. Both active and ambush foraging strategies are employed, and the diet consists almost entirely of endotherms. When young (<750 mm SVL), birds (and, to a lesser degree, bats) comprise a significant portion of their diet (likely captured via active foraging while the birds are at roost) but, with increasing size, mammals (especially rodents) become their principal prey. Frogs and lizards are taken infrequently by *C. hortulanus*.

References

Henderson, R.W. 2002. *Neotropical Treeboas: Natural History of the* Corallus hortulanus *Complex*. Krieger Publishing Co., Malabar, Florida.

Pizzatto, L., O.A.V. Marques, and M. Martins. 2007. Ecomorphology of boine snakes, with emphasis on South American forms, pp. 35–48. In: R.W. Henderson and R. Powell (eds.), *Biology of the Boas and Pythons*. Eagle Mountain Publishing, Eagle Mountain, Utah.

LAURIE J. VITT

Although *Corallus hortulanus* demonstrates tremendous color and pattern variation throughout its range, this individual exhibits a much higher percentage of white scales than typically observed. It was captured in a small section of bamboo forest near the Rio Cristalino in northern Mato Grosso, Brazil. The habitat is transitional between southern Amazonian rainforest and the vast savanna-like Cerrado to the south. A second snake with similar coloration was found several days later. Whether these individuals are just variants of an extremely variable species or a color pattern anomaly is unknown.

Villagers at the high-elevation sites where Boelen's Pythons (*Morelia boeleni*) are found still use traditional methods to hunt.

Serpent in the Clouds: Research and Conservation Efforts for the Boelen's Python (*Morelia boeleni*)

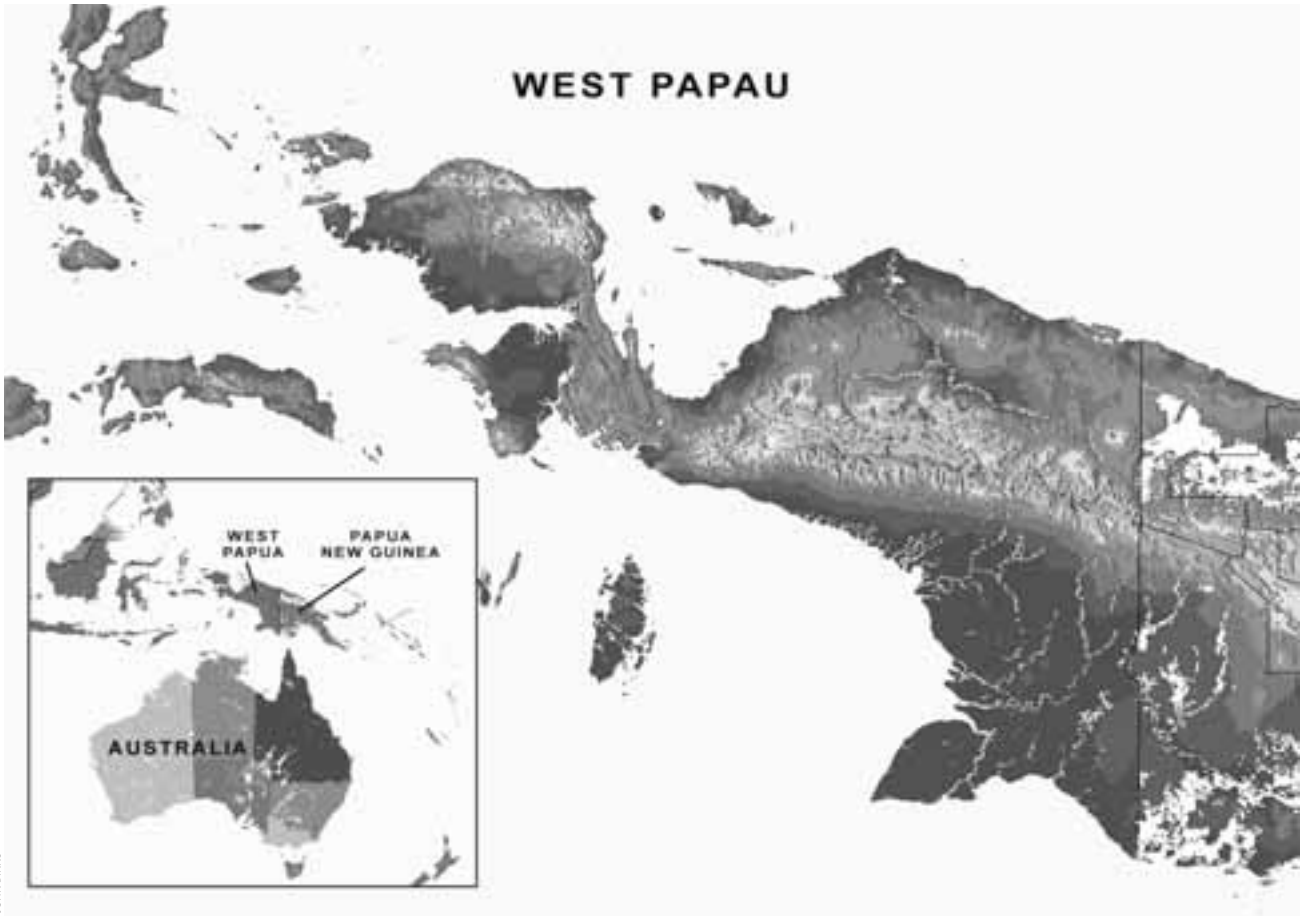
Ari R. Flagle and Erik Stoops

Center for Reptile and Amphibian Research
Phoenix, Arizona

Photographs by Al Baldogo and Ari R. Flagle.

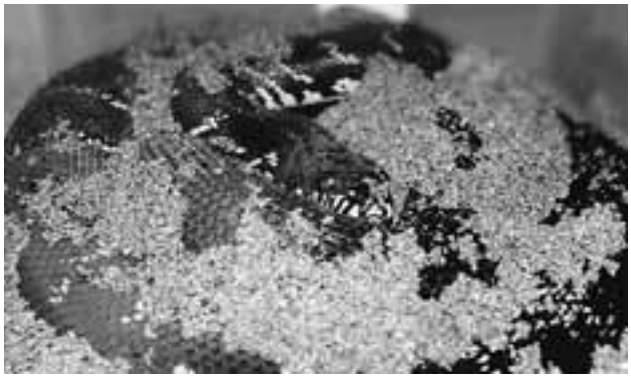
Soaring mountains expand from the far east of Papua New Guinea (PNG) to West Papua Indonesia (Irian Jaya). This tropical island remains one of only a handful of the world's preserved environments and undisturbed regions. Here, nestled deep in the mountains of Papua Indonesia, hidden by the slow-moving mist of the clouds, dwells a creature discovered only fifty years ago and still living unchanged and unmolested by the outside world.

The habitat of Boelen's Python (*Morelia boeleni*) is virtually unknown. Access to the area is difficult and extremely dangerous due to the inhospitable topography, and locals are averse to guiding outsiders into remote areas. Local inhabitants report tales of cannibalism, and, in the past ten years, several newspaper accounts seem to provide evidence that such practices still occur. So, traveling to the highlands of Papua Indonesia to search for *Morelia boeleni* is not an adventure one chooses lightly,



JOHN BINNS

Due to the rugged topography, the highlands of West Papua Indonesia (Irian Jaya) are among the most remote and unexplored regions in the world.



The unique natural habitat of *Morelia boeleni* creates several obstacles when attempting to duplicate the environment in captivity.

but after eight years of hands-on experience with this species, I (Ari) was determined to take the risk.

In 1997, we developed the Center for Reptile and Amphibian Research (CFRAR), which specializes in caring for a diverse selection of exotic and difficult-to-maintain species. Captivated as we were by the beauty and mystery of *Morelia boeleni*, it was at the top of our list. We began working with this snake during the winter of 1998. In 2004, we wrote the first comprehensive book (*Black Python*) dealing with the husbandry of the species. During the winter of 2006, Eric proposed an idea for a television series called "Reptile Chronicles," which would incorporate an animated reptilian host. As the subject for the first segment, we selected the Boelen's Python and shortly thereafter left for the uncharted mountains of Papua Indonesia.

From Ari's travel journal:

There are many names for M. boeleni *throughout Indonesia; Wallow, Hitam Wallow, or Boelen. In Java, the indigenous people call them "Sanca bulan."*

June 2: *Feels like I have been here for months. Seven planes and three days traveling. Armed soldiers all over. My bags were emptied of medication, food, tools, batteries, and other small items that momentarily appealed to the baggage handlers. The effort required to simply make the trip is strenuous work for both the body and the mind. I finally understand why most people do not come here: it is just too difficult. The journey by truck is indescribable and I find myself mesmerized by the culture and the physical environment. Never having been in this part of the world, I am experiencing a sense of overwhelming sadness for the people. The economy is such that they have to work for little or nothing in order to survive. We really take for granted what we have. I am feeling morose; I look into the distance and see the mountains above and the clouds rolling over the jagged faces of a virtually untouched environment that is calling to me. No matter how tired I am. I cannot stop. This is why I am here.*

June 3: *The squatters (toilets) have buckets of dirty water and ladles. You flush by pouring a ladleful of water into the hole. It's taking me a little bit to get used to, but at least it's a toilet. The sewer system is essentially a continuous ditch, five feet deep, that parallels the walking paths. It is filled with all the refuse and fecal matter in the village. It was shocking to witness a local man miss the path and swerve his bicycle into the squalid ditch. My instinct was to jump in after him, but my guide grabbed my arm and wouldn't allow it.*

Ari was quite a celebrity. Villagers hunted, slaughtered, and pit-roasted a wild pig in his honor.

Villagers were proud of their prowess with traditional weapons.

June 4: *We arrived in Irian or, as it is now called, West Papua, Indonesia. As soon as we landed, our little plane was swarmed by locals: people wanting handouts, selling trinkets, and trying to help us carry our bags for money. I let a man carry my gear and he asked me,"nama saya?" This means, "Is your name Mickey Mouse?" I laughed and told him my name was Donald Duck and that I was grateful for his help. Many people trying to be western-like — kind of sad. The culture is so rich — why change it? After an uncomfortable night's sleep, we were met by the truck that would transport us to the mountains.*

June 5: *The mountains are amazing! We arrived at our base village. The villagers hunted, slaughtered, and pit-roasted a wild pig in our honor. I don't eat pork but felt compelled to show my appreciation for their hospitality. Then we geared up and set off into the mountains — bad idea! This hike was like nothing I have ever done in my life. We climbed a 70% grade of slippery rock and vegetation. The path used by the indigenous people is very narrow. Then, to top it off, I added 40–50 lb. with my backpack. I stepped off the path and my foot fell through the ferns. Almost lost that one! As I anticipated, the temperature range is from 90 °F in the lowland areas to 75–85 °F in the high country. Breathing is difficult due to the thin air. There is also some talk about another tribe that continues to practice cannibalism.*

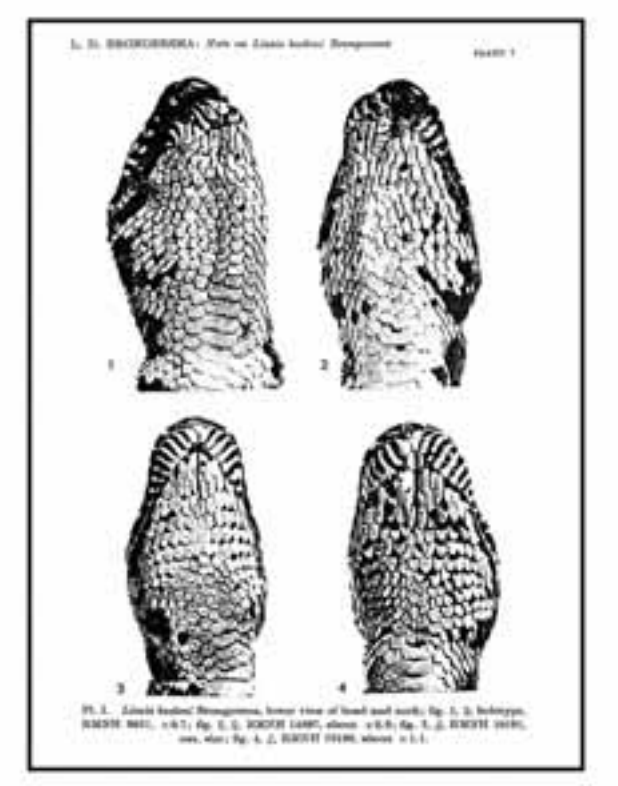
June 6: *After the rigorous climb, we arrived at the next village in late afternoon. Set up my tent at the edge of the village, then passed out. I awoke shivering from the unexpected cold. Came out of my tent, looked up, and was in awe. The mountains were dense with vegetation and thick clouds were slowly moving over them. It was truly breathtaking. We took temperature readings. They read 44 °F.*

June 7–8: *Scouting the mountains is extraordinarily exhausting. There is not much visible reptilian life. I found a huge spider web that spanned at least 12 x 12 ft., fishing-line thick.*

June 9: *One of the villagers handed us a bag. "Wallow, Wallow," he said. I looked in and sure enough... It was not just the snake, it was the man and the expression on all our faces. I felt an overwhelming shared connection with these people, their culture, their mountains, their wildlife, and fauna. My research and work at the center had not prepared me for this experience. Yet, theoretically, the writings of Worrell and Brongersma provided me with a solid reference in schematics for identification of the Boelen's.*

This snake (male) was first observed in Dimija on 25 December 1952 by a man named Dr. K.W.J. Boelen. On March 1955, the second and third animals (females) were collected in Okito by R. Den Haan. The fourth animal was collected by R. Den Haan a substanial distance away at Wissel Lakes. The last animal observed and collected was by a man named Dr. C.J. Royer on 19 February 1963 west of Lake Paniai. Prior to this discovery, L.D. Brongersma (1953) described a new species of Serpentes, Boidae (pythons were at that time considered to be in the same family as boids). A portion of the description reads, "Rostral as wide as high, visible from above, with a deep groove on each lat-

The mountains were dense with vegetation.



In his original description of the species in 1953, L.D. Brongersma noted "possible differences in color of the chin and throat of the animals collected. This might be related to the sex of the animals captured, males possessing more black marking under the dorsum of the chin and females showing more yellow. They have been noted in the wild to reach lengths of 14 feet and the girth of a grown man's leg."

Brongersma noted a "head uniformly black above. Rostral black with the outer borders of the labials yellow. The yellow stripes do not reach past the under shield of the eye or nostril. The body is adorned with jet black and yellow stripes covering the lateral side and dorsum of the snake."

eral side. Internasals 1.2 times as long as wide. Anterior prefrontal only very slightly longer than broad (length 12.2 mm, width 12.0 mm), 1.3 times as long as the internasals... A head uniformly black above. Rostral black with the outer borders of the labials yellow. The yellow stripes do not reach past the under shield of the eye or nostril. The body is adorned with jet black and yellow stripes covering the lateral side and dorsum of the snake."

Information from this original description confirmed that it was indeed the same species of snake, but classified by a different name. A specimen reported to have been collected from the Lae territory of New Guinea was described by Eric Worrell in 1958. The animal, named *Laisis toronga* was by description a specimen of *Liasis boeleni* (the species since has been reassigned to the genus *Morelia*). It was collected from within a chain of mountains in the center of New Guinea. Both individuals described the same scalation and coloration. L.D. Brongersma noted "possible differences in color of the chin and throat of the animals collected. This might be related to the sex of the animals captured, males possessing more black marking under the dorsum of the chin and females showing more yellow. They have been noted in the wild to reach lengths of 14 feet and the girth of a grown man's leg."

In the early 1980s, when these pythons first appeared in the United States, they originated from eastern Indonesia (PNG) and differed in length and girth from animals imported more recently. Stripes were white, and the animals were heavier and more muscular. Today's captive-hatched and farm-bred animals in Indonesia are primarily adorned with yellow bands. They are slim and fast.

The areas where the nest sites are located were extremely dangerous and difficult to reach. The exterior nest areas were covered with shed and scat. Steep slippery rocks and immense amounts of vegetation were everywhere. All climbers had to step carefully on a narrow path or risk falling 100 feet or more through underlying ferns. In order to survive, an animal must be able to navigate the deep, narrow rock crevices to reach shel-

Boelen's Pythons live at high elevations in the remote mountains of West Papua Indonesia (Irian Jaya). Although lowland temperatures are around 90 °F, high country temperatures are 10–15 °F lower by day and drop into the 40s at night. Breathing is difficult due to the thin air. Locals mention another tribe that continues to practice cannibalism.

ter. In a captive setting, we know that these snakes are highly agitated even after acclimation to new environments. We have noticed that they are uncomfortable with large amounts of space, but are equally anxious with too little room. After experimenting, we found that an enclosure 6 x 3 x 3 ft. was most acceptable. In captivity, snakes appear to prefer isolation except during the breeding season from August to December.

The area inhabited by Boelen's Pythons is high in elevation; the clouds roll in during early morning and dissipate in late afternoon. In our center, we create conditions in which we incorporate low light with relatively high UV output. In the mountain areas, basking sessions occur throughout the day when the cloud cover breaks, allowing rocks to absorb heat. We maintain basking lights for up to two hours at 90 °F, at which time the automatic system shuts off, enabling the enclosures to cool slightly (80–85 °F). We repeat the cycle at midday. Shortly after the last basking session, a simulated mist provides a light rainfall that generates the humidity calculated to reach between 40–60%. Care must be taken when utilizing misting units to avoid excessive moisture. The enclosure must include at least one dry area.

Clouds roll over the jagged faces of a virtually untouched environment.

Considerable speculation has surrounded the issue of what these snakes feed on in the wild; presumably their diet consists of small birds, bats, and small mammals. While inland, we did not see any ground-dwelling birds; however, our presence might have been enough to scare them away. We did notice an abundance of burrows. Most of these burrows appeared to belong to bandicoots, small rabbit-like marsupials. In captivity, Boelen's Pythons are fed primarily rodents. Small, thawed chicks may induce stubborn snakes to feed.

Several individuals active in the reptile trade in Indonesia regularly produce Boelen's Pythons. Why do the captive snakes in Indonesia reproduce, but snakes imported from the same country do not? One important consideration has to do with natural factors that we can not replicate. Among theses are elevation, climate, ultraviolet lighting, temperature, humidity,

The areas where snakes occur are extremely dangerous and difficult to reach. Steep slippery rocks and immense amounts of vegetation were everywhere. We climbed a 70% grade of slippery rock and vegetation.

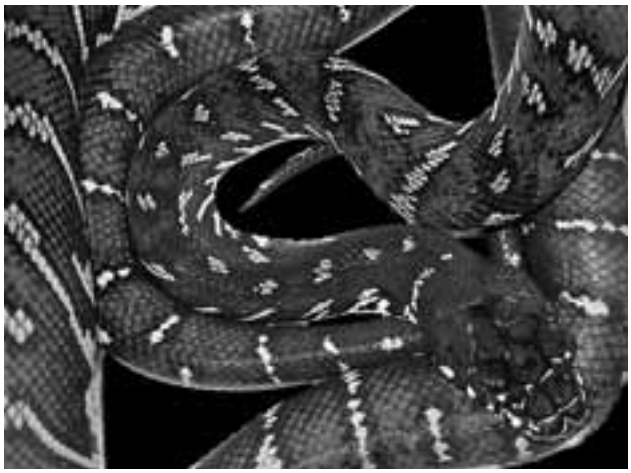
moisture, soil, vegetation, and other wildlife. The uniquely remote habitat of *M. boeleni* creates several obstacles when attempting to duplicate the natural environment. Research with captive-hatched offspring is necessary, because these animals are more likely to adapt to an artificial environment.

Burrows were abundant and most appeared to belong to bandicoots, small rabbit-like marsupials. In captivity, Boelen's Pythons are fed primarily rodents. Their natural prey is unknown.

Breeding this snake is not difficult, but the process of actually producing eggs in captivity is quite challenging. To our knowledge, only two successful captive breeding records are known — and these were never recreated. Animals that are imported into the country are usually dehydrated, infested with worms, and have suffered considerable stress from capture and transport. Most animals perish within several months, and those that survive have a relatively short life in captivity. When two sexually mature animals (typically 2–3 years of age for females and less for males) copulate, they subsequently display all of the distinctive signs of becoming gravid. Females will generally increase

To date, captive breeding of Boelen's Pythons outside their native range has failed for reasons yet unknown, although captive-hatched or captive-bred animals from Indonesia regularly enter the wild animal trade.

In captivity, these snakes remain highly agitated even after acclimation to new environments.



Captive-hatched and farm-bred animals in Indonesia are primarily adorned with yellow bands. They are slim and fast.

The striking black and yellow pattern of Boelen's Pythons helps to break up their outline, making them more difficult to see for both predators and prey.

The Indonesian government pays close attention to the high prices that Boelen's Pythons fetch in private and black-market sectors, and a yearly limit on sales is carefully controlled. Proof of a legitimate sale and appropriate paperwork are required before any of these rare snakes are permitted out of the country.

the period of basking and gradually refuse to feed. Females also gain in size and girth and display classic pre-lay shedding behavior. Unfortunately, in captivity, after shedding takes place, the animals fail to deposit any eggs. Why these animals fail to reproduce in a captive setting is unknown. Of several hypotheses we have considered, one suggests that the compatibility of the pair is dependent on location. In the wild, biological markers such as shed skin hanging from nearby bushes and trees and feces around the nest site may allow snakes instinctively to recognize potential mates. We also think that a specific set of pre-breeding behaviors is necessary to stimulate proper egg development.

For the past seven years, the CFRAR has operated a privately funded research project the primary goal of which is to shed light on the unique behavior and captive propagation of Boelen's Pythons. "Project Black Python" emphasizes conservation efforts for both captive and wild Boelen's Pythons. We prohibit the use of imported wild-caught adults as research subjects; only captive-hatched or captive-bred animals from Indonesia are allowed to be shipped. The Indonesian government pays close attention to the high prices these animals fetch in private and black-market sectors, and a yearly limit on sales is carefully controlled. Proof of a legitimate sale and appropriate paperwork are required before any of these rare snakes are permitted out of the country.

We often wonder about the fate of these remarkable creatures as more and more land is lost to deforestation. Is the only means of successful propagation the creation of farms in the species' natural habitat? Will some individual come one step closer and produce viable eggs? When will we be able to raise these animals to adulthood and develop a lineage of true captive-bred Black Pythons? Hundreds of species go extinct every day. In the case of Boelen's Pythons, we sometimes wonder if we are meant to know more about them. Not long after they were discovered, they vanished back to the clouds from which they had emerged. Regardless, we intend to remain with them wherever the journey leads…

Acknowledgements

Special thanks to friend Al Baldogo for an adventure of a lifetime and JC2 Animated for taking on a great project.

BETH MITTERMAIER

An effort to remove Butler's Garter Snake (*Thamnophis butleri*) from the Wisconsin list of threatened wildlife has been thwarted for the moment.

The Little Snake That Could: Butler's Garter Snake in Wisconsin

Howard Aprill

Wehr Nature Center, Milwaukee County Parks

Photographs by Gary S. Casper except where noted.

After a contentious battle, a little garter snake has defeated opposition to its protection in Wisconsin — for the time being. The Butler's Garter Snake (*Thamnophis butleri*) was listed as a Threatened Species in 1997, based on an extremely limited range in the state, and rapid and ongoing habitat loss within that limited range. The snake lives in remnants of wetlands and grasslands (mesic prairies, marshes, roadside grassy areas, and vacant city lots) in the Milwaukee area, where it is isolated from other members of its species, the closest of which are in Michigan and Indiana.

These medium-sized snakes (total length = 38–51 cm) have a shorter, narrower head, a generally thicker body, and less of a constriction behind the head than other Wisconsin garter snakes. Dorsal ground color is brown, black, or olive with or without a double row of black spots between the stripes. Distinct lateral stripes are on scale row three and adjacent rows two and four anteriorly and most of scale rows two and three posteriorly. Stripes vary from light yellow to a rich orange-yellow color. The venter is green to yellow-green with dark spots along the lateral edges.

The principal food is earthworms, but leeches are sometimes eaten as well. In captivity, they may consume fish or frogs. In Wisconsin, they are active from mid-March through early November, and hibernate in underground retreats, especially crayfish burrows. Males mature in their second spring, females in their third. Mating occurs mostly from late March to late April. In Wisconsin, an average of nine young are born between July and mid-September.

Butler's Garter Snakes are sometimes killed in urban areas; this one along a trap line in a suburban neighborhood study site in north-central Milwaukee County appears to have had its head stomped. Usually this behavior is displayed by young boys, and is not likely to have significant impact on snake populations, although, in one instance, such indiscriminate killing persuaded a concerned citizen to capture approximately 300 Butler's Garter Snakes and move them "to a safe place" approximately 30 miles away. Such translocations probably result in the demise of the transported individuals, but also may be responsible for unnatural gene flow between populations or even species or the establishment of new colonies outside the natural range.

A female Butler's Garter Snake slithers across an access road at a central Ozaukee County research site. Co-occurring species at this site were Eastern Garter Snakes (*Thamnophis sirtalis sirtalis*) and Eastern Milksnakes (*Lampropeltis triangulum triangulum*).

Many of the populations of this species have been isolated from each other due to wetland loss and habitat fragmentation. These snakes already have a limited range, so habitat destruction is especially detrimental to them. Another concern is genetic swamping by the Plains Garter Snake (*T. radix*); this closely related species moves into the range of *T. butleri* and breeds with them. Only a handful of populations still exhibit only the characteristics of *T. butleri* , and most of those populations occur in Milwaukee County, the most urbanized county in the state.

Politics and Garter Snakes

On 18 July 2006, a majority Republican faction within the Wisconsin Legislature's Joint Committee for Review of Administrative Rules (JCRAR) voted along party lines to remove

the species from the state's list of threatened wildlife, a move which ignored all available science and which was at odds with recommendations from the state's own Department of Natural Resources (WDNR). Whereas no official reasons were given for this move, opinions expressed were that the snake was impeding economic development, cost too much to protect, and supporters of de-listing did not believe the species was actually threatened. However, no economic analyses were presented to support the first of these contentions, no evidence that the species was secure to support the second, and no evidence or scientific opinion that would refute the findings that had led to the 1997 listing to support the third. The JCRAR attached conditions to their ruling, specifying that the species would be removed from the Threatened Species list on 1 October 2006, unless:

a. The Department of Natural Resources (DNR) lowers its determination of the number of sites necessary to maintain the viability of the Butler's Garter Snake.
b. DNR formulates a plan to mitigate further the amount of land affected by the conservation needs associated with the Butler's Garter Snake.
c. DNR specifies parameters for the orderly delisting of the Butler's Garter Snake from the state's threatened species list.

The hearing was highly contentious. Peter McKeever, reporting for the Milwaukee County Conservation Coalition, noted: "To be generous, the science was ignored and ridiculed. It was an astounding and extraordinary demonstration of ignorance, arrogance, partisanship, bias, and lack of concern for the environment. It is shameful that the question of whether to de-list a species has become a partisan issue. The seven-hour hearing was largely a staged performance designed to satisfy a select group of political supporters. The politics were blatant: the committee clerk was observed exchanging hand signals with the lobbyist for the builders during the debate on the motion under consideration, à la Nero giving the thumbs up or thumbs down to gladiators in the lion pit."

On 27 September 2006, the JCRAR again took up the proposed de-listing. Again along strict party lines, the JCRAR approved a motion to rescind its earlier motion, and to make the rule suspension (i.e., de-listing) effective on 30 November 2006, unless the DNR "... updates its conservation strategy so that its policy relating to the Butler's Garter Snake is less burdensome on the private property owner."

The vote followed some compromises from DNR on the timing and cost of reviews and surveys, and a promise to reduce the amount of protected area for the species. However, no guid-

Crayfish burrows are heavily utilized by Butler's Garter Snakes as underground retreats. These, in northeastern Waukesha County, probably are occupied by either Devil Crayfish (*Cambarus diogenes*) or Prairie Crayfish (*Procambarus gracilis*), the two most common burrowing species in southeastern Wisconsin. The burrows descend to the water table, and offer snakes hibernating retreats in winter and drought refugia in summer. Butler's Garter Snakes appear to be especially abundant in areas of high crayfish burrow density.

Labial scales (those forming the "lips") of Butler's Garter Snakes typically have little or no black edging, as shown in this individual.

High quality habitat is typified by this floodplain habitat along Poplar Creek in northeastern Waukesha County. Diverse grasses afford patchy sun penetration to ground level, so that snakes may cryptically bask partially hidden in clumped grasses, where they are less obvious to avian predators. The diverse wet meadows and grassland also provide variance in root densities, making it easier for burrowing crayfish to find places to dig. In contrast, thick monotypic stands of invasive plant species, such as Reed Canary Grass (*Phalaris arundinacea*), form tall (2 m) stands of uniform stem and root density, which do not provide basking opportunities for snakes and make digging very difficult for crayfish. The scrape in the center of the photo is periodically inundated during floods and spring snowmelt, and is riddled with crayfish burrows.

A Butler's Garter Snake-occupied development site in New Berlin, Wisconsin, where snakes were removed from the construction footprint. A former peat bog, adjacent habitat is being restored and managed for Butler's Garter Snakes as part of the development agreement.

ance was forthcoming from the JCRAR as to what might be accepted as "less burdensome," nor why this vague requirement should trump biological issues in maintaining the species as viable in Wisconsin. Members of the minority made efforts to find a compromise, and all were rejected on party line votes. In reference to the idea of basing species protections on "burden" instead of science, minority member Rep. Spencer Black opined: "We can change the laws of the State of Wisconsin, but we cannot change the laws of nature."

Representatives of the DNR consistently defended the principle, which is also the law, that the only basis for de-listing a species is sound science that shows that it is no longer threatened. A strong majority of the public, including the Wisconsin Wildlife Federation, came out against the de-listing. Many expressed worry that de-listing without any regard for the science would set a dangerous precedent for endangered species recovery efforts, and would jeopardize Wisconsin's eligibility for federal wildlife funding. Even the Milwaukee Metropolitan Builders Association, a hitherto strong critic of protecting the snake (which affects many of their members' building projects), at this time opposed the de-listing, and supported the DNR position to revise its conservation strategy — perhaps recognizing that the loss of state protection and the consequent further decline of snakes might lead to even stricter state or federal regulations in the future. In the face of this overwhelming support for the snake and the Endangered Species Law, the JCRAR majority still voted to de-list. The postponement of the de-listing date was widely viewed as politically motivated, with several Republican members up for re-election on 4 November.

At this development site in South Milwaukee, snakes were confined to a wetland while most of the upland habitat was developed. Here, heavy rains have raised water levels beyond the limits of the snake fencing. Under the existing regulations, the state has the authority to allow sites of less than 20 acres of suitable existing Butler's Garter Snake habitat to be completely developed, with only voluntary snake conservation measures. These smaller sites are considered to be less important to the species' long-term conservation and survival.

Finally, on 28 November 2006, the JCRAR reconvened and voted 7–2 to not remove the snake from the protected list. What changed? The Republicans lost their majority in the state Senate in the 4 November election, and therefore their majority and co-chairmanship of the JCRAR. Any de-listing presumably would have been swiftly reversed when the new Senate convened in 2007.

Butler's Garter Snakes are still found in vacant lots in industrial and commercial areas. In this approximately 9-acre site in west-central Milwaukee County, 64 Butler's Garter Snakes were trapped in two days in early October.

To avoid and minimize "take" (a legal term meaning killing individual snakes), construction projects may use silt fencing to prevent snakes from moving into work areas. The fences must be placed between the upland and wetland portions of the habitat, while snakes are hibernating in the wetlands. When snakes emerge in the spring, they are prevented from dispersing into the upland habitat being developed. In this photo, a snake exclusion fence is in the foreground, a snake survey fence in the center, and another exclusion fence in the background, beyond which a new storm water retention pond has been graded and seeded. The storm water facility is designed as a "dry pond," which will have standing water only for brief periods and be naturally vegetated. It therefore will continue to provide snake habitat after construction. Currently a "no-net-loss" of snake habitat policy is in place, so many development projects may proceed by altering and then restoring snake habitat in this manner.

A typical adult Butler's Garter Snake from Pewaukee, Wisconsin.

Many landowners are hostile toward both the snake and those who work with it, whereas others place high value on its conservation, especially parents whose children routinely play with this harmless urban species. Some of the stories are comical, and illustrate some of the human tensions involved with achieving conservation in areas where land values are high. A herpetologist I know was retained to perform snake surveys by a private couple wanting to develop their property. The consultant set up his survey traps and the landowners, distrustful of all scientists, followed the consultant and his assistant each day, watching their every move. One day, the consultant received a call from his assistant, who was checking the traps that day. She said several traps smelled strongly of mothballs, but she couldn't investigate too closely because the landowner was watching like a hawk. Intrigued, the consultant sniffed the traps the next day, and also smelled mothballs. He then ordered some commercial "snake repellant," and when it arrived — it too smelled strongly of mothballs! Nevertheless, several Butler's Garter Snakes were eventually trapped on this site, and the landowners have since attended public meetings and legislative hearings where they accused the consultant of "planting" the snakes on their property. Snake repellants are never mentioned.

Although the snake remains protected, the fact that the threat of de-listing was used to force a compromise in favor of development is troubling. The Wisconsin DNR continues to work toward revising its protection plan, having promised to reduce protection for the snake to favor private landowners. They have retained the Conservation Breeding Specialist Group (Apple Valley, Minnesota) to assist them with population viability analyses and plan revisions.

Web Resources:

http://www.fortwayne.com/mld/newssentinel/news/local/16116112.htm
http://www.dnr.state.wi.us/org/land/er/herps/snakes/butlersgrt.htm

JOHN BINNS

Glenn releasing a re-captured *Cyclura pinguis* after replacing the bead-tags used for individual identification (July 2001 at Bones Bight, Anegada, British Virgin Islands).

PROFILE

Glenn P. Gerber: Doing It His Way

Arthur C. Echternacht[1], Allison C. Alberts[2], and Gene Gerber[3]

[1]University of Tennessee, Knoxville; [2]Conservation and Research for Endangered Species, San Diego Zoo, San Diego, California; [3]Brockport, New York

Childhood photographs by Glenn's parents unless otherwise indicated.

"What are you going to be when you grow up?" When a child is asked that by a favorite aunt, it's just a question, a bit of small talk. By high school, the question takes on added weight, and by college, it can be a real source of stress for many students. Students often jump from major to major, seeking something that excites them or in which they think they can excel. Many students, for example, enter college with a career in medicine in mind, until an unfortunate experience in an organic chemistry or physics course suggests otherwise. The person who "knows" early in life what he or she wants to do with that life, and is able to follow through, is fortunate indeed. Glenn Gerber is such a person.

Born a long time ago in Salt Lake City, where his Dad taught English at the University of Utah, Glenn was the youngest of three children. The family moved to San Luis Obispo, California while Glenn was still a toddler. In California, he discovered reptiles. Lizards were abundant, and Glenn and his brother caught them and put them in shoeboxes for storage in the garage. Glenn's mom, Gene, remembers that the boxes were always tipping over, resulting in a healthy population of lizards in the family woodpile. Glenn decided, at that very young age, that he wanted to be a herpetologist, and he even knew what the word meant. Being a cowboy or fireman just wasn't good enough.

Glenn in 1965 holding two of his presents on his fifth birthday. His sister, Vivien, looks on suspiciously.

Glenn at age 4 in the spring of 1964 in San Luis Obispo, California; his preschool graduation and the beginning of a long career as a professional student.

After a move to Vermillion, South Dakota, in 1966, the family finally settled in Brockport, New York, where Glenn's dad was a member of the faculty of the State University of New York at Brockport. Glenn started kindergarten in Brockport and began to amass a library of books on reptiles and fish. He collected shells (labeling each with the common and scientific name), cacti, and fossils, and began to fill the house with aquaria and cages. He kept all sorts of animals that he had caught himself and any animal that didn't respond well to life as an exhibit had to be returned to the exact spot where Glenn had caught it. This meant that animals in Glenn's care tended to live to ripe old ages, but everything has to die eventually. When that sad event inevitably occurred, the carcass was rele-

Glenn at age 13 in his bedroom with a Green Iguana — a look to the future?

gated to the freezer, where it shared space with the ice cream until Glenn performed the post-mortem on an old cutting board in the kitchen. He had arranged for a steady supply of mice to feed his snakes from the biology department at the University, but occasionally had to rely on a pet store when his usual source dried up. His Mom often was delegated to pick up the unfortunate rodent, and, at least once, one escaped from its box on the way home and made driving difficult as it ran around on the floor and under the pedals.

As he progressed through grammar school and high school, Glenn developed an interest in art and photography, and he retains those interests today. In the field, he wouldn't be caught dead without his camera, and he's a wonderful photographer.

Glenn graduated from high school in 1979 and attended Cornell University as an undergraduate, graduating in 1983 with a Bachelor of Science degree in Biological Sciences. Following a year of working in the Rocky Mountains and Grand Teton National Park, he enrolled as a graduate student in Biological Sciences at the State University of New York at Brockport. The budding herpetologist's Master's thesis was on the behavior and ecology of centrarchid and salmonid fish in Lake Ontario. The project had strong conservation overtones and, among other things, involved radiotracking fish from an airplane in all sorts of weather. Graduating in 1987, he was probably happy to move to the warmer environs of Knoxville, Tennessee, where he enrolled in the doctoral program in ethology to study lizards. His dissertation research dealt with behavioral and ecological interactions between a native lizard, the Green Anole (*Anolis carolinensis*) and an introduced relative, the Brown (or Cuban) Anole (*Anolis sagrei*). The Brown Anole had been introduced accidentally about 50 years earlier in southern Florida and was expanding its range rapidly northward (it has now reached South Carolina). Upon the arrival of Brown Anoles in a new area that is occupied by Green Anoles, and especially if that area is disturbed in some way, the Brown Anole population flourishes while that of the Green Anole declines. Glenn's study was intended to gain a better understanding of the mechanisms by which an introduced species has such a negative effect on a closely related relative. The study had unanticipated consequences. Glenn learned that Brown Anoles had been introduced to Grand Cayman, an island south of Cuba. A small island, Grand Cayman is home to a unique anole, the Grand Cayman Blue Anole (*Anolis conspersus*), and concern was expressed that the same fate suffered by Green Anoles in Florida might affect the native lizard on Grand Cayman. Glenn and his adviser just had to go to Grand Cayman to check this out — and that led to many trips and to an expansion of Glenn's dissertation topic. To cut the story short, the native anole on Grand Cayman apparently can hold its own against the invader.

During one of these trips, Glenn's adviser took him to Little Cayman to see the rock iguanas (*Cyclura nubila caymanensis*). Glenn took an immediate interest in the iguanas. Part of this was driven by the knowledge that the native iguana on Grand Cayman, the Grand Cayman Blue Iguana (then *Cyclura nubila lewisi*; now thought to be a distinct species, *Cyclura lewisi*) was nearly extinct, and efforts to develop recovery and management plans were hampered by a lack of information on the lizards' ecology. Nevertheless, the iguanas on Grand Cayman are closely related to the iguanas on Little Cayman, which were still fairly abundant. So an ecological study of the animal on Little Cayman might offer clues that would assist in developing plans to save the Grand Cayman population. Glenn applied for and

TODD CAMPBELL

Capture! Glenn on French Cay, Turks & Caicos Islands, another of the cays to which iguanas were translocated.

SUE KEALL

Glenn holding one of the offspring of the original group of Turks & Caicos Iguanas translocated to Middle Cay.

was awarded a Fulbright Fellowship to study the iguanas on Little Cayman. He had completed the fieldwork associated with his dissertation research, and the plan was for him to spend nearly a year on Little Cayman studying iguanas while writing the dissertation. He headed off to the island with his computer and a library of books and papers on anoles, but he should have known better. The last thing one wants to do after spending all day under the tropical sun in intense heat is work on a dissertation. He learned a great deal about iguanas, and his efforts did contribute substantially to the conservation of the Grand Cayman Blue Iguana (he was given an award for his efforts by the National Trust for the Cayman Islands), but completion of his doctoral program was delayed considerably — and, those puny little anoles seemed a lot less interesting than their relatively huge relatives. Glenn was hooked on iguanas.

Not only was he hooked, he was an expert. That meant that, while still trying to finish his dissertation, he was being asked to take part in all sorts of fun and interesting field research on West Indian rock iguanas. However, to the delight and relief of his research adviser (and his parents), finish he did. Subsequently, he accepted a Millennium Postdoctoral Fellowship with the center for Conservation and Research for Endangered Species (CRES) at the San Diego Zoo. CRES had a long history of working with rock iguanas, as well as monitor lizards, and had funded Glenn's proposed reintroduction program for the critically endangered Turks & Caicos Iguana (*Cyclura carinata carinata*). His previous work surveying over 120 islands and cays in the Turks & Caicos Islands (TCI) had

TREY GRAHAM

Glenn weighing an egg on Little Water Cay, Turks & Caicos Islands, while doing a nesting study in 2004.

SUE KEALL

A little GPS work to log iguana data on Little Water Cay, Turks & Caicos Islands (2004).

TARREN WAGENER

Glenn and Joe Burgess taking a blood sample from an iguana on Little Water Cay, Turks and Caicos (2004).

GLENN GERBER

Fighting male iguanas on a small cay in Chalk Sound, Turks & Caicos Islands (1995).

prepared him well for designing a translocation program that would rescue and restore these remarkable animals to uninhabited islands on which they had once occurred.

Glenn quickly identified two source and four translocation islands that would serve as the basis for this ambitious program. He knew that Big Ambergris Cay, a hidden jewel at the southeastern end of the Caicos Bank, was slated for extensive development in the near future. Supporting over 18,000 iguanas by Glenn's estimation, Big Ambergris held key genetic diversity that could not be squandered. With a practiced eye, Glenn selected Six Hills Cay East and French Cay as two islands that would be capable of supporting healthy populations of iguanas, but which had lost their populations in the recent past, most likely the result of predation by introduced species.

At the same time, Glenn had long appreciated the ecological and social importance of Little Water Cay at the opposite end of the Caicos Bank. The Turks & Caicos National Trust had successfully developed this small cay into an ingenious model ecotourism operation that was generating more than $100,000 per year for iguanas and other conservation endeavors. Although the iguana population on Little Water was robust and healthy, Glenn had documented the recent invasion of feral cats onto the island. Knowing how quickly iguana populations can be decimated by these ruthless and efficient predators, Glenn immediately realized that the valuable genetic diversity represented in the Little Water population must be safeguarded as well. He proposed moving a limited number of iguanas from Little Water to repopulate Bay and Middle Cays, part of the Five Cays, a group of protected islets just offshore from the island of Providenciales. The government quickly and wisely granted permission for both the Big Ambergris and Little Water translocations to take place the following year.

Now the real work began. The Turks and Caicos banks collectively support seven major islands and more than 200 smaller islands and cays. From a logistical perspective, the translocations could proceed only with a dedicated research vessel. Finding the right boat wasn't easy, but fortunately Glenn knew exactly what he needed. After one false start that involved investigating the cramped and rough-water challenged *Gingerbread*, Glenn spied the 50' catamaran *Aquanaut*, and knew his search for the perfect research vessel was over. All she needed was a little work, right? A full year and a complete retrofit of water, electrical, and power systems (not to mention the addition of sleeping bunks, functional toilet, and customized iguana transportation roof rack) later, the project account was $70,000 poorer, but Glenn had learned more than he had ever hoped to know about boats — and the program was up and running.

GLENN GERBER

Female iguana looking for flowers on a Turk's Cap Cactus, Ambergris Cay, Turks & Caicos Islands.

ALLISON ALBERTS

Fieldwork is hard work!

GLENN GERBER

Male iguana on Little Water Cay, Turks & Caicos Islands (2003).

Appropriately rechristened the *Cyclura*, her maiden voyage to Big Ambergris under the unflappable Captain Gerber was a huge success. In a memorable experience, the *Cyclura*'s first crossing of the Caicos Bank was marked by mirror-flat calm waters and an escort of dolphins. That was the first of many such voyages (some not nearly so calm and uneventful) that resulted in the successful repatriation of 218 iguanas over a two-year period. By collecting samples both pre- and post-translocation from source and translocation islands, Glenn spearheaded a groundbreaking study of the nutritional and physiological stress experienced by translocated animals. Although evidence suggested initial stress and weight loss, Glenn worked with a dedicated group of scientists, veterinarians, and stalwart volunteers to document full recovery within five months of translocation. The translocated iguana populations have grown at a phenomenal rate, and females as young as two years have reproduced, truly remarkable for a species in which the usual time to reproductive maturity is six to seven years. Glenn continues to monitor the reintroduced populations, which have shown an astounding 95% survival rate. By all accounts, the program continues to be an unqualified success. In 2002, Glenn was honored with the Conservation Award of the Turks & Caicos National Trust for his many achievements related to iguana conservation in the TCI.

At one point, Glenn's work in Turks & Caicos had led to his own physiological stress. With a couple of other biologists, he was on the boat miles from a medical clinic in Providenciales, the most populated island in the Turks & Caicos Islands, when he became seriously ill. His colleagues, who were not exactly seasoned sailors, had to get the semi-delirious Glenn back to civilization. There, he was diagnosed as having pneumonia, and ultimately was flown to Miami, where he had access to better medical care, but his condition was still misdiagnosed. Not until months later did a suggestion by another CRES biologist lead Glenn to insist on the blood test that would confirm that he had Dengue Fever.

Always at home in the field, Glenn has continued to mentor fellow iguanaphile Kelly Bradley in her studies of headstarted Anegada Iguanas (*Cyclura pinguis*) in the British Virgin Islands. Together, they designed an innovative experiment that would determine the optimal size at which to reintroduce headstarted juveniles back into the wild. Their hard work has led to the successful repatriation of over 100 iguanas into their native habitat, a vastly improved captive management program, and the basis for a model educational campaign that teaches visitors and residents alike about the need to conserve iguanas and their habitats. This year, Glenn will be working closely with the non-profit group Island Conservation to develop much needed invasive species management plans for both Little Water Cay and Anegada Island. Glenn continues to serve the IUCN SSC Iguana Specialist Group as a long-time Steering Committee member and to provide critical advice and assistance to iguana conservation programs worldwide.

Glenn's postdoctoral fellowship ended in 2005, but the San Diego Zoo was fortunate to be able to keep him on as an expert consultant. Soon thereafter, he became the full-time Caribbean Program Head at CRES, where he continues his work with iguanas. He recently founded the TCI-based non-profit Caribbean Wildlife Foundation, dedicated to the conservation of iguanas and other native wildlife throughout the Caribbean. Glenn is a gifted and dedicated colleague who has done more to advance the cause of science-based iguana field conservation than anyone we know, and we all owe him a tremendous debt of gratitude. He is a conservation biologist who has truly made a difference. Although neither he nor his parents realized it at the time, his toddler's interest in reptiles turned into an exciting career.

The dangerously venomous Spectacled Cobra (*Naja naja*) is the main attraction for snake charmers in Bangladesh.

TRAVELOGUE

Destination Bangladesh: From the Himalayas to the Bay of Bengal

AHM Ali Reza[1]

Department of Natural Resources Management, Texas Tech University, Lubbock, Texas 79409, USA

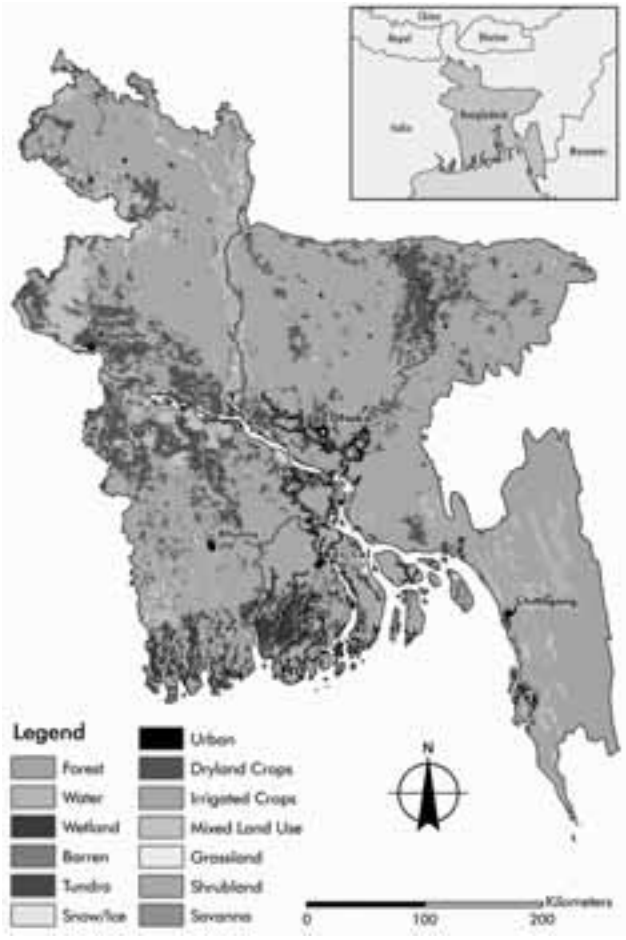
Photographs by the author.

I begin my story in Dhaka, the swirling and chaotic mega-city capital. The metropolitan area houses 11 million, making Dhaka the largest city in Bangladesh, and one of the most populous cities in the world. One does not enjoy a casual stroll through Dhaka. A trip to the city's center means bushwhacking through throngs of garishly decorated rickshaws, buses held together by Bondo putty, and taxis that belch and wheeze around the clock. Dhaka also is not a pleasant-smelling city; a hint of sewage and humanity always hangs in the hot and sticky air. City people are generally very friendly, but many speak only Bangla. Therefore, having a local guide is advisable if not familiar with the language, culture, and customs. However, just miles away from frenzied, industrialized Dhaka, the landscape changes dramatically and reveals a verdant flatland covered by hand-tended rice fields and palm trees waving lazily in the heat.

Bangladesh is situated between the Indo-Himalayan and Indo-Chinese subregions of the Orient. With 147 million people occupying roughly the same area as Iowa, Bangladesh is among the most densely populated nations on earth, but this mostly agricultural country rarely makes the news in the West. Within its nearly 144,000 km^2, the country contains a number of diverse ecosystems supporting roughly 113 species of mammals, 628 birds, 126 reptiles, 22 amphibians, 708 species of freshwater and marine fish, about 400 species of mollusks, and 140 bees and wasps, many of them on the nation's list of threatened animals. Few systematic studies have been conducted on the biodiversity of the country (formerly East Pakistan) since British scientists published their last book in 1943.

The current species list of Bangladesh, produced by IUCN Bangladesh in 2000, was prepared broadly based on collections made by British researchers a century ago. The country has neither a natural history museum nor a long-term biodiversity con-

A trip to Dhaka's Newmarket area in the center of the nation's largest city means bushwhacking through throngs of garishly decorated rickshaws, buses held together by Bondo putty, and taxis that belch and wheeze around the clock.



Bangladesh is situated between the Indo-Himalayan and Indo-Chinese subregions of the Orient.

[1] Permanent Address: Department of Zoology, Jahangirnagar University, Savar, Dhaka 1342, Bangladesh. E-mail: wild_reza@yahoo.com

Brightly colored and noisy Tokay Geckos (*Gekko gecko*) are common in most old buildings.

servation strategic plan. Thus, this mainly Muslim, impoverished, overpopulated, and poorly explored country is now drawing attention from researchers and conservationists around the globe. As a native, I wanted to initiate a research and conservation program on the herpetofauna of Bangladesh, the least known and most neglected group of animals in the country. My research goals included the production of an updated species list, a set of GIS-based distribution maps, and estimates of species composition and richness in various habitat types.

Based on various geographic, biological, and logistical factors, I selected seven permanent sampling sites (PSSs) in five different forest types: evergreen, semi-evergreen, deciduous, mangrove, and swamp forest, and three study sites in urban and suburban areas. I planned to spend at least one week in each of my PSSs, which required a lot of paperwork. Worth mentioning here is that bureaucracy in a developing country is sometimes very frustrating, and is the main obstacle to conducting research. Nonetheless, the summer of 2006 found me exploring hot and humid tropical forests with some graduate students from the Department of Zoology, Jahangirnagar University and other assistants. Jahangirnagar, one of 28 public universities in Bangladesh, is in the district of the capital city, Dhaka.

We headed northeast into the Lawachara National Park, a 1,250-hectare, highly diverse evergreen forest. The park is the home to several primate species, including the only ape of the country, the Hoolock Gibbon (*Hylobates hoolock*). A bus ride of about six hours got me to the nearby township of Srimangal. This was not a peaceful journey, Bangladeshi drivers are not known for staying in their lanes. From there, we made our way to the national park headquarters in a "rickshaw," a locally-made three-wheeled vehicle pulled by a human, only to be informed that my team would not be allowed to use the Hilltop Forest Rest House, the only place to stay overnight in the park. This meant we had to walk in each night, a journey of about 10 miles. On the way out from the forest around midnight, we found *Leptobrachium smithii*, a dark frog that had not been recorded from the park. Two lizards that had not previously been

Lawachara National Park is a 1,250-hectare, highly diverse evergreen forest.

reported from the country were also recorded: *Scincella reevesii*, a common ground-dwelling skink, and *Ptyctolaemus gularis,* a relatively uncommon *Calotes*-like agamid lizard that we found about 2 m high on a tree-trunk.

Undulating red soil and Sal (*Shorea robusta*) forest are the main ecological features of Madhupur National Park, my next PSS. Sal forests are relatively dry and have been dramatically reduced during the last few decades, but a few older stands remain and provide a home for serpents. Nocturnal and deadly venomous, the Banded Krait (*Bungarus fasciatus*) is considered "endangered" in Bangladesh. Normally, these snakes are very

The Green Fan-throated Lizard (*Ptyctolaemus gularis*) was recorded for the first time in Bangladesh.

Undulating red soil and Sal forest are the main ecological features of the deciduous forest.

Reeves's Ground Skink (*Scincella reevesii*), another first record for Bangladesh.

We found a Sri Lankan Painted Frog (*Kaloula taprobanica*) in a head-high tree-hole.

secretive and very difficult to locate, but I found several fresh roadkills on the road that meanders through the 8,438-hectare deciduous forest in north-central Bangladesh. We recorded a brightly colored microhylid, *Kalophrynus orangensis*, which has recently been proposed to be synonymous with *K. interlineatus*, for the first time in Bangladesh. *Kaloula taprobanica*, another dark, painted microhylid also was collected from a head-high

We recorded the Sticky Frog (*Kalophrynus interlineatus*) for the first time in Bangladesh from Madhupur National Park.

Like many other Asian ranids, *Sylvirana leptoglossa* has been subjected to prolonged taxonomic debates.

tree-hole. This is the first voucher specimen of this species from the country. Many Asian ranids have been subjected to a long taxonomic debate. We recorded an abundance of the noisy *Rana leptoglossa* (the recently revised name of which is now *Sylvirana leptoglossa*) from the park, and this also was a first record of the species from the region. We noticed the Berdmore's Narrow-Mouthed Frog (*Microhyla berdmorei*) in great abundance during late-June.

My next destination was Comilla Tipperah Hills, a degraded Sal forest habitat in east-central Bangladesh that experiences flash floods during the rainy season. Most of the hilly areas are already clear-cut, and considerable development occurred during the last couple of decades. We did not find any old trees or a good patch of forest, and decided to conduct surveys in the agricultural fields nearby, from which we recorded mostly common species. We did find two new skink species of the genus *Sphenomorphus* (*S. maculatus* and *S. indicus*) that had not been recorded from Bangladesh. Among several other skink species, *Lygosoma bowringii* was a new record for the country, considerably extending its range from the nearest know populations in Myanmar. We also observed breeding ranids, *Sylvirana leptoglossa*, which also represented a new record of the species outside Madhupur National Park in north-central Bangladesh.

Three mountainous districts occur in southeastern Bangladesh: Khagrachari, Bandarban, and Rangamati. These are covered in forests that extend from Myanmar and northeastern India, and are highly diverse, mostly intact, and poorly explored. Getting there required an eight-hour bus journey from Dhaka to Chittagong, then a three-hour bus ride to Bandarban, and finally a "chander gari," a locally produced four-wheel-drive jeep-like vehicle. My western friend had to get special permission, as foreigners are not normally allowed to visit these politically restless districts. While looking for amphibians and reptiles in the area, local people were constantly providing us information on sightings of frogs, snakes, and lizards. In response to such information, we were able to capture a Cat Snake (*Boiga*

Uncommon Berdmore's Narrow-Mouthed Frog (*Microhyla berdmorei*) is found frequently in Madhupur National Park.

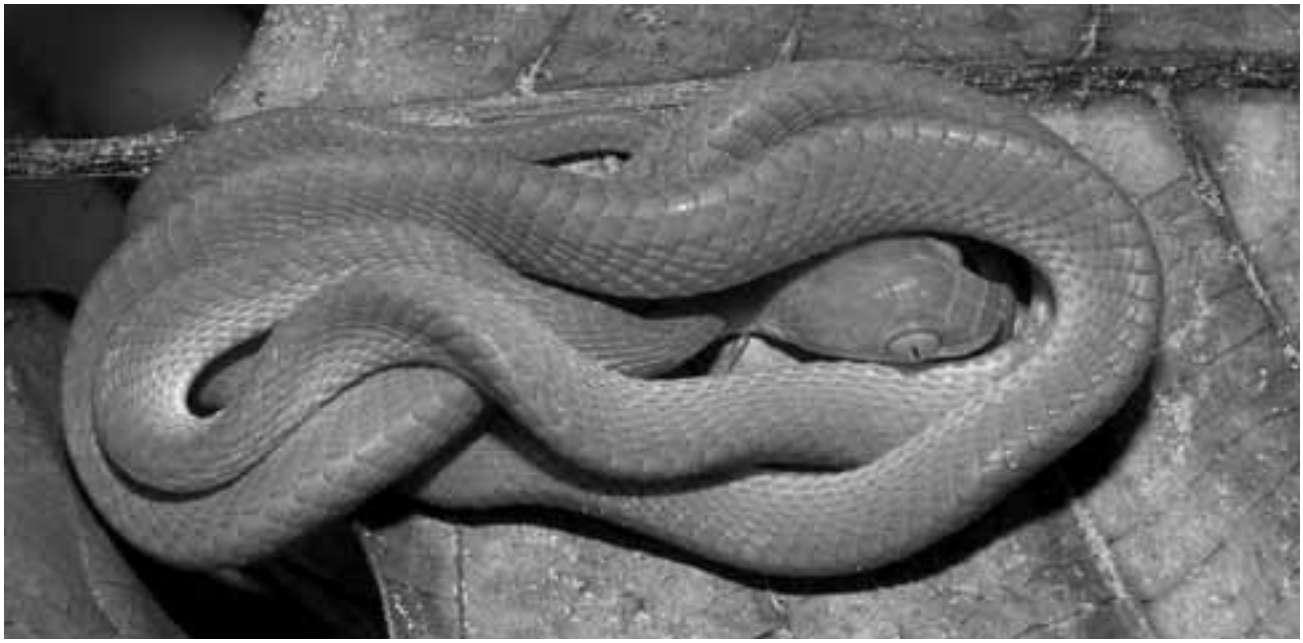
We recorded Bowring's Supple Skink (*Lygosoma bowringii*) for the first time in Bangladesh.

Spotted Litter Skinks (*Sphenomorphus maculatus*) are common, but were recorded for the first time from Comilla Tipperah Hills.

ochracea) and a very fast-moving Trinket Snake (*Coelognathus radiatus*), inside our "well-protected" hillside resort campus. We also collected several species of skinks, the most important of which were *Lygosoma lineolatum*, which had not been described in earlier records, *Sphenomorphus maculatus*, which we had found already in the Camilla Tiperah Hills, and *Eutropis macularia*, which was quite common in the area. We spent more than an hour capturing a *Calotes versicolor* sleeping high in a tree at night inside the resort. Mountain streams are quite common in these three hill districts, and we recorded a megophryid frog, *Xenophrys parva*, by one such stream.

Haor is an internationally important seasonal wetland that includes numerous rivers, streams, irrigation canals, and large areas of seasonally flooded cultivated plains. Situated in northeastern Bangladesh, the Haor Basin is one of the most remote areas of the country. The Tanguar Haor is a 97.3 km^2 UNESCO "World Heritage Site," and an important wintering and breeding ground for migratory birds. Water depths in the Haor vary from 5–10 m during the wet season and 1–4 m in some shallower wetland areas. We hired a boat especially designed to cruise in shallow water, but could not conduct a thorough survey this year because of logistical problems. We are planning to do so in the coming years. We did, however, record several species of common frogs and aquatic snakes (e.g., *Enhydris enhydris*, *Xenochrophis piscator*, etc.). We also found a few softshell turtles (*Aspideretes gangeticus* and *A. hurum*) that had been captured by local turtle hunters who we encountered on the way to local fish markets. We collected tissue samples for DNA analyses.

The Khagrachari, Bandarban, and Rangamati hill districts are covered in evergreen forests.



The mildly venomous nocturnal Tawny Cat Snake (*Boiga ochracea*) was only found in the Bandarban Hills.

This small Bronze Grass Skink (*Eutropis macularia*) is widely distributed in plains and hilly areas throughout the country.

Local people often were a good source of information for finding amphibians and reptiles in unfamiliar areas.

Common Smooth Water Snakes (*Enhydris enhydris*) are common in most wetlands in Bangladesh.

Indian Softshell Turtles (*Aspideretes gangeticus*) are still common in large rivers like the Brahmaputra and its tributaries.

Indian Roofed Turtles (*Pangshura tectum*) are popular in pet markets in Dhaka.

A good population of King Cobras (*Ophiophagus hannah*) remains only in the Sundarbans mangrove forest.

My final destination was the Sundarbans, the largest chunk of productive mangrove forest in the world, and another World Heritage Site that extends through both India and Bangladesh. At the mouth of the mighty Ganges, this wide area of impenetrable mangroves supports a varied and fascinating array of natural and anthropological treasures. The Bangladeshi Sundarbans covers an area of about 5,770 km^2, of which 4,016 km^2 is land and the rest is composed of rivers, canals, and creeks. Only a couple of centuries ago, the Sundarbans was twice its current size, but much of it has been altered. It is a crucial conservation area hosting Bengal Tigers (*Panthera tigris tigris*) and many other species, including the world's largest venomous snake, the King Cobra (*Ophiophagus hannah*), and the world's largest living reptile, the Estuarine Crocodile (*Crocodylus porosus*). This mangrove area also is one of the world's most effective cyclone barriers, and also serves as a food factory capable of feeding our children in perpetuity. Transport in the Sundarbans is difficult and dangerous, especially during the cyclone months. We rented a boat and launched from Khulna, the last human habitation in the northern part of the Sundarbans, and spent most of the time onboard. Our little "Titanic" carried several thousand gallons of freshwater and enough food for the whole team to eat, drink, and take showers for an entire week.

I end my story on Katka Beach, situated south of the Sundarbans mangrove forest, on a crisp and gorgeous day, with no one else to enjoy the wide swath of powdery white sand beach that stretched from horizon to horizon. The Earth's biodiversity is being lost at a frightening rate, and we must act now to conserve our life support system. We humans, who have been given the power and wisdom to achieve so much, should recognize that protecting ecosystems and wildlife will ultimately ensure our own survival. Bangladesh is an impoverished, overpopulated, beleaguered, and mostly forgotten country, but those of us from southern Asia have a headstart on the rest of the world because of our positive attitude towards nature. We respect other life forms and are grateful for the gifts nature bestows upon us.

The dangerously venomous Spectacled Cobra (*Naja naja*) is the main attraction for snake charmers in Bangladesh.

Acknowledgements

A very special thanks to my academic advisor Dr. Gad Perry, who encouraged me to write this article and reshaped the very first draft, and to Dr. Aaron M. Bauer, who critically reviewed the manuscript. Financial support for my project was provided by the Rufford Small Grants for Nature Conservation, the Conservation Research Small Grants of Cleveland Zoological Society and Cleveland Metroparks Zoo, Turtle Survival Alliance (TSA), and Texas Tech University. Finally, I thank my field crew, Stephen Mahoney from Ireland, Dr. Peter Praschag from Austria, Md. Abdul Aziz, Md. Kamrul Hasan, and Kamal Hossain from Jahangirnagar University, for their help and companionship in the field.

HISTORICAL PERSPECTIVES

The Rattlesnake and Natural Selection[1]

Prof. N. S. Shaler

For some years I have been teaching that the tail appendage of the rattlesnake was not to be explained on the doctrine of natural selection, inasmuch as it could contribute in no way to the advantage of the animal. It seemed to me quite clear that it was rather calculated to hinder rather than to help the creature in the race of life by warning its prey of its presence. Nor did it seem easy to account for its existence by supposing that it was used as a sexual call and had been brought up by natural or sexual selection for some such office. The burrowing habits of the serpents would seem to make sexual calls almost unnecessary and there is no evidence to make a reasonable basis for belief that rattlesnakes exercise any such choice in pairing as would lead to the development of this very singular appendage. Last summer, however, I had a long desired opportunity of examining a little into the habits of the rattlesnake and obtained some results which have served to shake my confidence in the opinions I had held as to the usefulness of his rattle. The observations are, as it will be seen, rather insufficient for a determination of the points in question, but it may be long before I am able to add to them, so I give them now hoping that some one with better opportunities for studying the ways of this interesting creature may either confirm my opinion or refute it.

The first and only living and active rattlesnake which I met on a carriage journey of some months' duration made during the past summer through that part of the Appalachian chain where these serpents most abound was in the middle of a road near the Kishicoquillas Valley, Pennsylvania. As the sound of my carriage disturbed the surly fellow in his pleasant basking place in the dusty way, he begun to sound his warning when we were over a hundred feet from him. Although quite accustomed to the sound, having had specimens captive for months at a time, I mistook it for that made by our "locust," the *Cicada rimosa* Say, nor did I perceive the error until my companion, Mr. A. R. Crandall, called my attention to the serpent when we were within forty feet of it. My wife and child, a little girl of eight years, who were in the carriage also mistook the noise for that made by the Cicada, which was abundantly familiar as it had been for a long time the most accustomed sound heard while we were traveling through the wooded mountain country.

SUZANNE L. COLLINS, CNAH

Prof. N. S. Shaler suggested in 1872 that the purpose of the rattle was to attract prey, specifically birds searching for cicadas, the call of which was purportedly mimicked by the buzz of the rattle. His encounters were with Timber Rattlesnakes (*Crotalus horridus*), which are widely distributed in the eastern United States (although extirpated by humans from many areas where they once were abundant).

JACK GOLDFARB, WWW.JACKGOLDFARB.COM

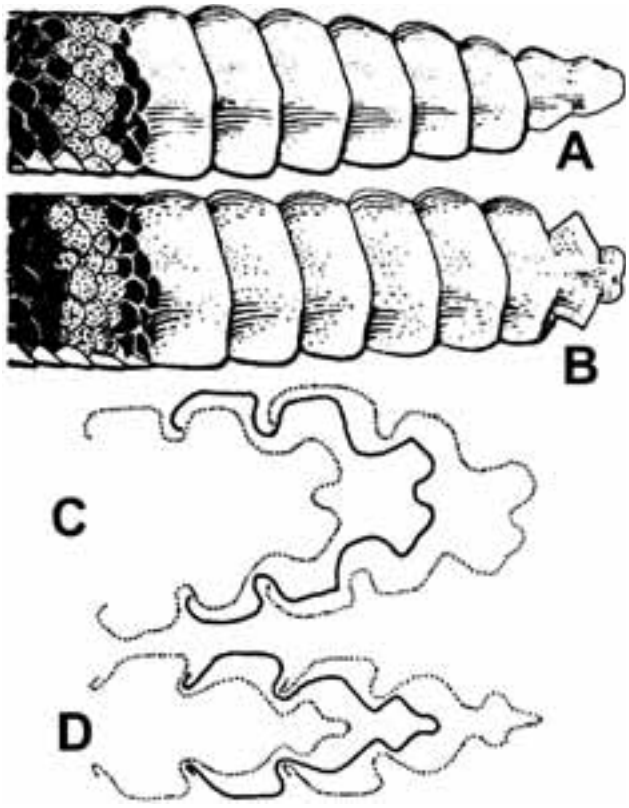
The interlocking segments of the rattle generate a "buzz" when shaken rapidly, such as by this Timber Rattlesnake (*Crotalus horridus*). Although superficially similar to the call of a cicada, the likelihood that rattlesnakes mimic an insect to attract avian prey is very slim, and belied by the fact that rattlesnakes feed almost exclusively on mammals.

I have found that the note of the rattlesnake is recognized by many persons as indistinguishable from the sound made by the Cicada. Professor Brewer, whose long experience in the service of the California Geological Survey gave him quite unrivalled opportunities for becoming familiar with the sound made by this reptile, tells me that he was on one occasion at least in great danger of being bitten by one of these animals on account of having supposed that its persistent rattle was only the whirring of a locust. The range in pitch in the rattling sound of the snake is quite great; it is even difficult to understand how sharp it can be from a study of the sound made by the animals tamed by captivity, but at the same time the note of the locust is also very variable so that one is not able to discriminate by this means. The reader will doubtless have caught the main point towards which these facts so plainly tend, namely, that the imitation of the note of the locust may possibly be of high value to the rattlesnake. The Cicada furnishes the most satisfactory mouthful to many of our birds. Almost every observer of the life of our

[1] Reprinted from *The American Naturalist* 6:32–37 (January 1872).

woods and fields, has seen a bird spying around a branch whence came the whirring of a locust; suddenly there would be an end of the monotonous sound, and a moment after the bird would be seen, beating the wings off the insect by pounding it against the ground. It is quite evident that any animal which preyed upon birds would gain a decided advantage from being able to imitate the sound made by the creatures on which the birds fed, so that we can well imagine that those snakes endowed with the power of attracting birds would be the best fed and multiply the most rapidly. From this point of view we can also understand how it is that birds have been seen fluttering around a rattlesnake without calling into play the unreasonable agency of fascination; the bird in this case being in search of his food and decoyed into the range of the serpent's spring.[2] It is a well known fact that birds, even those which have the best determined notes, are easily misled by sounds which approach, even though imperfectly, the calls of their species or the sounds of their prey, so that the imperfections in the note of a rattlesnake when considered as an imitation of the Cicada cannot count much as an argument against this view.

If this view be correct, then we must regard the rattle of the rattlesnake as a useful appendage, and not an instrument calculated to do it injury by warning its prey of its presence.[3] But it is by no means so easy, even if we allow all that can be claimed for natural selection, to account for the development of this appendage. The following seems to me the most satisfactory conception of its evolution, looking at the matter from Mr. Darwin's point of view. It is a fact well known, doubtless, to those who have observed serpents, though I find no mention of it in the works I have consulted, that many serpents, when in a state of excitement vibrate the end of their tail just as the rattlesnake does.[4] This movement is likely enough the same in character as that which occurs in the hinder part of the spinal column among higher animals under excitement. The wagging



The anatomy of a rattlesnake rattle: A. A complete rattle showing the terminal "button." B. A broken string of rattles showing a terminal rattle (but not the original button). C. & D. Vertical and horizontal cross sections through interlocking rattles. Adapted from Klauber (1972. *Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind*. 2nd ed. 2 vols. University of California Press, Berkeley and Los Angeles).

of the dog's tail is a rhythmical movement of essentially the same character as the movement of the rattlesnake. Taking the same line of argument as that adopted by Mr. Darwin with regard to the monthly phenomena observable among the mammalia, it could be claimed that the tendency to move the tail was explicable on the following grounds. During more than half the lifetime of the group of vertebrates, from the point of their presumed origin at the close of the Silurian down to the present day, the caudal portion of the body was used as a propelling agent. Fishes, with slight exceptions, propel themselves with a reciprocating movement of the tail. All conditions of excitement at once manifest themselves in the violent movement of this part of the body. Whether in flight or chase or under the influence of sexual excitement, this movement is the important element of success. It is by no means surprising that the motion which was for ages the point which natural selection operated most intensely, for those forms which had the capacity for making this alternate movement of the tail with the greatest rapidity would be most successful in flight or chase, should have survived its usefulness and remained as a mere feature of expression in most of our animals. It may be remarked in passing that the obstinate survival of the tail among the vertebrates may be accounted for by the intense bodily inertia, if we may so call it, which causes the energy of survival of useless structures to be proportionate to the length of time which they have been of use to the groups

[2] I had an opportunity, recently, of seeing a living Cobra de Capello in a state of excitement. The first impression was how entirely unlike any other serpent it was. The broad, flat banner-shaped neck upon the slender staff of the body would readily lead one to suppose that it was something very different from a snake. I can readily imagine that animals which had learned, by selection or otherwise, to shun creatures shaped like serpents, would be easily misled by the strange shape of the cobra and fail to avoid it or even be attracted towards it by the curiosity which animals often show to see closely or even smell any strange object.

[3] Rattlesnakes of the genus Crotalophorus [= *Sistrurus*] make little or no noise with the imperfect rattles of the tail. In this genus, therefore, there could have been no advantage derived from imitation. It may be said, however, that the rattles which have little functional value in this genus, if making a sound be their real function, are even more irregular in number and shape than in the Crotalus. The truth probably is that there is an inherent tendency to form rattles in this groups of serpents and these structures are seized upon by natural selection and made functional.

[4] Since the above matter was put in type, I have learned that Prof. Jeffries Wyman made a communication to the Boston Society of Natural History, concerning the occurrence of this movement in the tails of snakes other than the rattlesnake, some two or three years ago. I have failed to find any notice of the communication in the Proceedings of the Society, though there can be no doubt that this eminent naturalist should be credited with the priority on this point.

to which they belong. It is natural enough that a part of the body situated at one of the regions of manifold relations as the tail is, and unappropriated to any special function, should be put to use in various ways, as a prehensile instrument by some monkeys and other animals, or a building tool by the beavers, as a fly-brush by many others, etc.

Mr. Herbert Spencer has already suggested that the wagging of the dog's tail and similar movements of that appendage is in fact an escape of nervous force restrained from other modes of expression at the moment. Looking at the matter from this point of view, which is doubtless quite satisfactory, we may reconcile it perfectly with the views which have just been presented by supposing that the ancient and no longer functional channel of escape for nervous force, the tail, has remained the way of outlet for the suppressed energy of the animal. The older the channel the less easy it is to close it either by volition or by natural selection.

Be the cause of the persistence of the tail and its movement what it may, we are still justified in assuming as the starting point, that the progenitor of the rattlesnake had the alternating motion of the tail common among snakes. It is the opinion of some herpetologists that the rattles are the remains of the skins successively shed by the animal. The rate of development of the rattles, together with the fact that the skins of some serpents are more imperfectly detached from the region about the tail than at other parts of the body, makes this view very probable. Let us suppose that we had a group of poison-fanged serpents, accidentally tending to keep the tail skin in the peculiar fashion of rattlesnakes and that in some of these it was persistent enough to make the whirring sound of the Cicada when the tail was rapidly moved under excitement. These would survive and breed the most surely and so that feature would become hereditary. The great variability in the number of rattles in the different forms of rattlesnakes and the late time of their development, even among those which differ in no other regard, would seem to indicate that this structure has not yet been firmly fixed by long inheritance.

The reader will please not suppose that because I have boldly followed the lead of the most advanced of the champions of natural selection that I am convinced of its sufficiency as an explanation of the great diversities which exist among animals or of its being sufficient basis for an explanation of the snake's rattle. But having been driven step by step from a decided opposition of the whole theory and compelled to accept it as a *vera causa*, though I think one much more limited in its action among animals than Mr. Darwin believes, I feel it to be my duty to examine every one of those points upon which I have relied for evidence against it.

It must be confessed that the case of the rattlesnake seems to me no longer the bar to the acceptance of the theory it once did.

Use of the Rattles of the Rattlesnake[5]

J. G. Henderson

It seems that the singular structure from which the subject of these notes derives its name, was intended as a special stumbling block in the path of antidarwinists, or to intensify the "struggle for existence" which the Darwinian theory, like all other theories must undergo.

SUZANNE L. COLLINS, CNAH

J. G. Henderson, also in 1872, disputed Shaler's assumption that rattles were used to attract prey and proposed instead that they serve as a warning directed at potential predators. Many of his observations were of Western Massasaugas (*Sisturus catenatus tergeminus*), at that time placed in the genus *Crotalophorus*.

In most notices I have seen of the rattles of the rattlesnake, they have been mentioned as though they were of no advantage to the possessor, and that natural selection would never produce them but on the contrary would weed them out, if that theory were correct. It seems to me that the whole trouble in the matter arises from the assumption that the sound of the rattles, as a war-cry, is a disadvantage to the reptile, by calling the attention of its enemies to it and thus inviting its own destruction, and that consequently the only way to reconcile the existence of the rattles with the theory of Darwin, is to show that there is some other use made of them and that in striking the balance between the profit and loss sides of the ledger, the line falls on the side of the former and for that reason natural selection produced and retains the rattles. If I understand him rightly, this is the view of the matter taken by Prof. N. S. Shaler in his paper in the January NATURALIST. He says that for some years he has "been teaching that the tail appendage of the rattlesnake was not to be explained upon the theory of natural selection, inasmuch as it could contribute in no way to the advantage of the animal; that is seemed to him quite clear that it was rather calculated to hinder than to help the creature in the race of life by warning its prey of its presence." But he intimates that he is now ready to say, that this appendage can be explained upon

[5] Reprinted from *The American Naturalist* 6:260–263 (May 1872).

the theory of natural selection. He considers the idea that it might be used as a sexual call as untenable, but that the whirring sound of the rattles closely imitates the sound made by the Cicada and for this reason is used as a call-note, as a hunter uses his bone-turkey-caller, to induce the bird to come within the range of his weapon. Now the first question which naturally arises is this: Does the snake sound its rattles when seeking to capture its prey? I have always understood that it is only when it throws itself upon the defensive and prepares for battle that the rattles are sounded; that it is an alarm note, a war-cry, and not a gentle, deceptive invitation to the victim. I have never seen a rattlesnake, and know of course nothing personally of its habits. But if this use is not made of the rattles as suggested by Prof. Shaler, and the sound only serves to call the attention of its enemies and thus invite destruction, then indeed is the theory of natural selection nonplussed. But as I view the matter, instead of inviting his destruction by sounding the rattles, it is one of the most effective means of self protection and is as useful to it in the race for life as is the growl of the tiger when threatened with danger. The snake does not sound its rattles until it considers itself discovered, and not then unless it apprehends danger. It throws itself in position to strike and says in unmistakable language, "Look out, I am ready for you!" If pushed upon, it makes its leap at its antagonist, and again throws itself in position to renew the conflict, and again sounds the note of defiance; a note calculated to alarm and, like the war-whoop of the Indian, strike terror to the heart of the assailant; but it may be said that the Indian only utters his yells when rushing on his enemy, or when actually engaged in the conflict, and the sounding of the rattles upon the first approach of danger is a disadvantage. Now it seems to me, if this were true and if it be a piece of rashness upon the part of the snake thus early to exhibit his combatativeness, that natural selection would cure the matter by selecting and preserving the more timid, and that, eventually, rattlesnakes would only sound their tail-bells when it would best promote their interests.

We are not to judge of the advantage or disadvantage of the rattles by their effect upon the nerves of man alone, though no doubt many a man has turned his back and been deterred from making an attack by the sound of these rattles and the defiant attitude of their possessor.

The ability of the snake to defend itself does not consist in its strength or size, or in its power of overcoming its adversary by a prolonged conflict, for most of its enemies are its superior in size and strength. Nor does its deadly poison act quickly enough to secure its own safety when it is attacked, but, in most cases, the victim, after the deadly stroke is given may still revenge

JACK GOLDFARB, WWW.JACKGOLDFARB.COM

This Western Massasauga (*Sisturus catenatus tergeminus*) is initiating a strike from a coiled "ambush" position. Rattlesnakes use a sit-and-wait foraging strategy, contradicting the contention that the rattles were disoperative because the sound would "warn" potential prey as the snake approached. Instead, the distinctive "buzz" appears to serve as a warning directed not only at potential predators, but at large grazing mammals that might inadvertently step on an undetected snake.

JACK GOLDFARB, WWW.JACKGOLDFARB.COM

Prairie Rattlesnakes (*Crotalus viridis*) were locally abundant across the Great Plains at the time these articles were written. Many of the rattlesnake encounters reported by pioneers traversing the Oregon and Mormon trails were with this species. This snake is in a classic "defensive" position.

itself by the destruction of the snake. But the *certainty* of the effect of the poison serves as a warning and is advantageous, not in defense after the attack is made, but in *preventing* an attack from being made. If, then, the color of the rattlesnake were different from all harmless snakes, so much so as to render it conspicuous, this would be beneficial to it, by the readiness with which all animals would recognize it, and thus protect the snake by this notice of the deadly character of its weapons. If then a conspicuous color would be of advantage, it seems to me that any other means which it may be able to use in making known its character to any animal that may come near it, would be advantageous, and would be increased and preserved by natural selection, and that the whirring noise which it produces, in this view of the matter, admirably serves its purpose. In effect it amounts to this, and by experience its enemies learn to understand its language, "I am a *rattlesnake*, armed with what will be death to you if you come too near; give me a wide berth!"

Prof. Shaler remarks that it is a fact well known doubtless to those who have observed serpents, that many when in a state of excitement vibrate the end of their tail just as the rattlesnake does. This statement reminded me of a South American species described by Darwin in his "Voyage of a Naturalist" (vol. i, p. 123, Harper's ed.), where he says:—

> "Of reptiles there are many kinds: one snake (a Trigonocephalus, or Cophias), from the size of the poison channel in its fangs, must be very deadly. Cuvier, in opposition to some other naturalists, makes this a sub-genus of the rattlesnake, and intermediate between it and the viper. In conformation of this opinion I observed a fact, which appears to me very curious and instructive, as showing how every character, even though it may be in some degree independent of structure, has a tendency to vary by slow degrees. The extremity of the tail of this snake is terminated by a point, which is very slightly enlarged; and as the animal glides along, it constantly vibrates the last inch; and this part striking against the dry grass and brushwood, produces a rattling noise, which can be distinctly heard at the distance of six feet. As often as the animal was irritated or surprised, its tail was shaken; and the vibrations were extremely rapid. Even as long as the body retained its irritability, a tendency to this habitual movement was evident. The Trigonocephalus has, therefore, in some respects, the structure of a viper, with the habits of a rattlesnake; the noise, however, being produced by a simpler device."

It was these remarks of Darwin that first suggested the problem of the rattlesnake's tail to my mind, and, as I had thought considerably about the matter, of course I was deeply interested in the paper by Prof. Shaler; but I must acknowledge that, while many of his suggestions are correct and highly valuable, I was disappointed to find that the only advantageous use, in his estimation, of this tail appendage of the rattlesnake, is an imitative call-note to allure birds within its reach, and that, otherwise, it is rather a disadvantage than an advantage to be preserved and perfected by natural selection. If it is useful for both purposes, then there is a double reason for the action of natural selection. If it is not used as an imitative call-note, but is useful in the manner I have pointed out, then I have shown that it is explained by natural selection.

The Rattle of the Rattlesnake[6]

Professor Samuel Aughey

I wish to contribute my observations on the rattlesnake, having been specially favored in opportunities for the study of this reptile.

Of all the articles that have appeared on the subject in the NATURALIST that by Mr. Putnam appears to me to present the most satisfactory theory concerning the use of the rattles. I am satisfied that *one* of their uses is to bring the sexes together.

In July, 1869, I was engaged in surveying along the Logan river in Wayne County, Nebraska. After completing my contract I devoted a day to investigating the natural history of the neighborhood. While washing a collection of unios at the water's edge, I heard the familiar rattle of the Massasauga (*Crotalophorus*

[6] Reprinted from *The American Naturalist* 7:85–86 (February 1873).

Editor's Remarks

Rattlesnakes are iconic symbols of the American West. During the 18th Century, rattlesnakes became symbols of the American colonies and their fight for independence from the British. For example, Paul Revere showed the snake fighting a British dragon on the masthead of *The Massachusetts Spy* in 1774. In 1775, a letter attributed to Benjamin Franklin appeared in the *Pennsylvania Journal*, calling for the adoption of the rattlesnake as the symbol of the United States and saying, among other things, that the rattlesnake "never begins an attack, nor, when once engaged, ever surrenders: She is therefore an emblem of magnanimity and true courage. ... she never wounds 'till she has generously given notice, even to her enemy, and cautioned him against the danger of treading on her," leading to the motto "Don't tread on me," emblazoned on an early revolutionary flag.

Yet today, rattlesnakes invariably appear as "bad guys" in movies and books. Rattlesnake roundups still occur in many places, and focus on killing as many of these useful animals as possible. A proposed position paper from the American Society of Ichthyologists and Herpetologists "strongly opposes traditional rattlesnake roundups. Such roundups promote overexploitation of natural populations of wildlife, unnecessary killing and inhumane treatment of individual animals, degradation of habitat, and promotion of outdated attitudes toward important elements of America's natural heritage." We strongly agree with this statement.

Here we reprint several classic scientific papers focusing on rattlesnakes. In 1872, N. Shaler published a piece in the *American Naturalist* attempting to explain the function of the rattle. "For some years I have been teaching that the tail appendage of the rattlesnake was not to be explained on the doctrine of natural selection, inasmuch as it could contribute in no way to the advantage of the animal." However, having provided a "useful" purpose for the "appendage," he concluded that "it must be confessed that the case of the rattlesnake seems to me no longer the bar to the acceptance of the theory it once did." Later that year, and in the same journal, J. Henderson speculated on the evolution of the rattle and its possible function. The following year, Samuel Aughey proposed yet another possible explanation.

SUZANNE L. COLLINS, CNAH

Western Diamondback Rattlesnakes (*Crotalus atrox*) are icons of the American West. Yet today, these rattlesnakes invariably appear as "bad guys" in movies and books. Rattlesnake roundups still occur in many places, and focus on killing as many of these useful animals as possible.

Paul Revere showed an American snake fighting a British dragon on the masthead of *The Massachusetts Spy* in 1774.

Benjamin Franklin at one time called for the adoption of the rattlesnake as the symbol of the United States. That suggestion led to the motto and image emblazoned on this Revolutionary War era flag.

Today, these discussions, which occurred less than two decades after publication of Charles Darwin's *On the Origin of Species** in 1859, seem naïve. Even the language and the methods are archaic. For example, the almost indiscriminant use of "theory" speaks eloquently to the evolution of language (today we would substitute "hypothesis" for all applications other than to Darwin's theory of natural selection). Also, the heavy reliance on anecdotal observations and a readiness to draw definitive conclusions from them contradict modern scientific methods. Our knowledge has greatly increased in the intervening years, and our ability to test hypotheses about form and function is much more sophisticated. Nevertheless, 134 years after the last of these papers first appeared, many U.S. citizens still adamantly cling to their opposition of evolution.

Gad Perry

* Complete title: *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life.*

SUZANNE L. COLLINS, CNAH

In 1873, Professor Samuel Aughey indicated that the rattle might also be used to attract mates or allies in a struggle against predators. Like Henderson, many of his observations were of Western Massasaugas, although he also described an encounter with a Prairie Rattlesnake (*Crotalus viridis*), illustrated here.

tergeminus [= *Sistrurus catenatus*]). I quietly crept up the bank and cautiously looking over the level bottom I saw, at the distance of about thirty feet, a rattlesnake coiled up with head erect and gazing in an opposite direction from my position. Every three or five minutes the snake would cease rattling for a minute or more and then commence again. In about half an hour from the time that I first saw the snake I observed another rattlesnake approach the first one. Closer and closer the second one approached, until at length they met and indulged in a sexual embrace. I watched them for at least an hour and left them at last without disturbing them.

The next year at the Bow river in the same state I saw the same thing repeated under similar circumstances. In neither case could I ascertain whether it was the male or female that give the call.

I am satisfied that the theory that the rattle resembles the noise made by the Cicada, and that it is employed because of this resemblance to entrap birds, etc., is a mistake. I have been accustomed to the sound of the Cicada and the rattle of the rattlesnake from my youth, and soon learned to distinguish them, although there is betimes a striking resemblance between them. My familiarity with them was gained in my native state amid the Alleghanies of Pennsylvania. In the last week of June, 1869, I was on the Missouri flood plain in a dense timber in Cedar County, Nebraska. At the time there were many Cicadæ and multitudes of birds in the timber. One day I was sitting on a log, classifying a collection of flowers and plants. Suddenly I heard the well-known rattlesnake rattle. The snake was not more than forty feet from me. I could not have been the cause of its alarm as a large log lay between us and I had been quiet for nearly an hour. Even the Cicadæ were alarmed and disappeared, and soon not a bird was to be seen, but the rattling continued. Unfortunately, on the impulse of the moment, I killed the snake without waiting to see or learn the purpose of its rattling. Again I have noticed that the Massasauga, at least in Nebraska, is by far the most abundant far away from the timber, where the Cicadæ are rarely if ever seen.

These observations seem to me to point to the theory that the rattle calls the sexes together. In July, 1871, I was in the timber on the Missouri in Dakota County, Nebraska. I got sight of a Baltimore oriole (rare in Nebraska) which I was following as it flitted from twig to twig. As it swept near the ground a rattlesnake struck his highest notes and seemed to paralyze the oriole with fear. This snake was a Crotalus. The poor bird hovered near the snake and fearing that it might fall into its jaws I shot the reptile. This experience suggested the theory that perhaps an additional purpose of the rattle was to frighten its victims into submission and to protect itself by the terror it inspires from its natural enemies. However that may be, is it not a mistake to limit such a peculiar organ to any one single purpose? What is needed to determine definitely the natural history of the rattlesnake is closer and more accurate observation over a wide area, and by persons who are fitted by nature and education for such work. Unfortunately for science, the almost universal custom has been to kill the rattlesnake as soon as found, without waiting to learn its disposition and habits of life.

Once in the Dakota Nebraska timber I saw an attack of hogs on a rattlesnake. In a few minutes after the snake commenced rattling, three others made their appearance. They apparently came to the assistance of the first one, but all were killed by the hogs in a few minutes. Seven hogs were more than a match for four rattlesnakes. Here evidently the rattle was used to call for help. These belonged to the genus Crotalophorus.

COMMENTARY

What Do We Lose If We Lose the Frogs?[1]

Jeffrey P. Bonner

President, Saint Louis Zoo
St. Louis, Missouri 63110

KINGS PLAY CHESS ON FANCY GLASS STOOLS

Anyone know that sentence? It's a mnemonic device, a shorthand way of remembering the categories scientists use to classify all life on Earth. The first letters of each word are the keys:

KINGDOM, PHYLUM, CLASS, ORDER, FAMILY, GENUS, and SPECIES

Now, if I said that half of an entire kingdom was going to become extinct in the next five years — say, the Animal Kingdom — there would be widespread global panic. Little wonder, as it would be the end of life on this planet as we know it. On the other hand, if I told you that we just lost another species, you might shrug your shoulders. You might figure that losing a single species is a little like popping a rivet on an airplane. Planes have oodles of rivets. You wouldn't want to lose too many, and you wouldn't want to lose an important one — like the last rivet holding the wing on. But losing an occasional rivet isn't exactly catastrophic.

Where we have problems is toward the middle of our categories. For example, what if we only lose half a "Class" of animals? A Class isn't as broadly encompassing as a Kingdom or a Phylum, but it takes in a lot more than a species or a Genus. Is losing half a Class a catastrophe, or is it just another popped rivet?

[1] Reprinted with permission of the *St. Louis Post-Dispatch*, copyright 2006.

CAROLE SAUCIER

The Fire Salamander (*Salamandra salamandra*) is IUCN-Red-listed as being of "Least Concern" in view of its wide distribution, tolerance of a degree of habitat modification, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category. However, even such species need to be monitored carefully, as changes in status can occur rapidly.

JENNIFER M. GERMANO

The Maud Island Frog (*Leiopelma pakeka*) is endangered in New Zealand and listed as "vulnerable" on the IUCN Red List.

Well, we're about to find out. In the next five to ten years, about half of the different kinds of animals that make up the Class known as amphibians probably will become extinct. There are about 6,000 known species in the class of amphibians: frogs, toads, and salamanders take in most of them. As I write this, 32 percent of those 6,000 are threatened, and another 23 percent are believed to be threatened (we don't have quite enough data to make the call with absolute certainty).

Amphibians face many of the same problems that other threatened species face: Habitat loss, climate change, pollution, and so on. But they also face a unique challenge. There is a fungus, which was born in Africa, that is sweeping our planet. It's called the chytrid fungus, and wherever it arrives, it kills about 80 percent of the amphibians in the area within a year. It is lethal only at certain altitudes, so it won't destroy all of the world's amphibians, but more than half is a pretty conservative estimate.

Scientists working with the St. Louis Zoo just confirmed that it's here in Missouri. The fungus cannot be stopped in the wild. Our only hope is to get to the amphibians before the fungus arrives and bring them into zoos and aquariums for breeding and safe-keeping. The hope is that the fungus subsequently will run its course, after which the animals can be released again. Call it "protective custody."

We do not know what the assault of the chytrid fungus means for the web of life that sustains us. Frogs and their kin are both predators and prey. They are critically important in sustaining the delicate balance of nature. But are they just another rivet or do they keep the wings on the plane? The skin of amphibians is more permeable than ours — things pass through it fairly easily — so they have developed some unique biological strategies to protect themselves. For example, their skin produces a wide variety of substances that kill microbes and viruses.

JENNIFER M. GERMANO

JENNIFER M. GERMANO

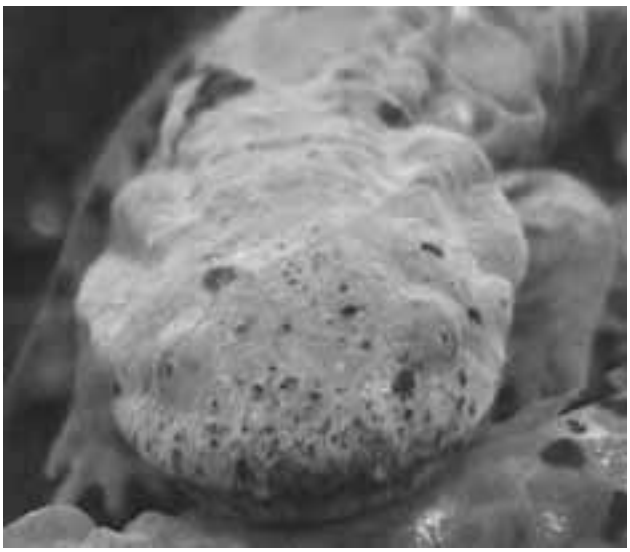
The Southern Bell Frog (*Litoria raniformis*) is endangered in Australia and listed as such on the IUCN Red List. However, introduced populations in New Zealand currently are doing well — but may be susceptible to the chytrid fungus, which has been documented in New Zealand during the past decade.

JAN P. ZEGARRA

JAN P. ZEGARRA

JAN P. ZEGARRA

Captive-breeding programs, including that at the St. Louis Zoo, are working to reestablish the critically endangered Puerto Rican Crested Toad (*Bufo lemur*) in its natural habitat.



THERESA CROW, MISSOURI STATE UNIVERSITY

This juvenile Ozark Hellbender (*Cryptobranchus alleganiensis*) at the St. Louis Zoo WildCare Institute is part of an effort to save this species. Declining populations throughout this "near-threatened" species' range are attributable to habitat degradation, predation on eggs and larvae by exotic species, and agricultural run-off that might interfere with normal reproduction.

Last year, 14 of these substances, taken from just a handful of different frog species, were tested in a lab; three of the 14 showed a remarkable capacity to completely inhibit HIV infections. I was surprised that a discovery that shows such promise for inhibiting the mucosal transmission of AIDS didn't make the news, but maybe I shouldn't be: The fact that we're going to have some very silent nights on this planet in just a few short years hasn't attracted much attention, either.

Contemplating the silence that will replace the thunderous evening chorus of amphibians' calls is bad enough. Even worse is that with the loss of those species, we will lose so many cures for so many things. And it is worse still to imagine what losing half of the world's species of amphibians may mean as we struggle to keep our living airplane from disintegrating.

When I studied biology in high school, I had a delightful mental image of those Kings Playing Chess while sitting On those Fancy Glass Stools. Now it turns out that we are very much like those kings: Idling away our time when we should be responding to a horrible threat to our Kingdom. It is not too late to save many — perhaps most, maybe even all — of the amphibians. They are comparatively easy to find and keep healthy in zoos and aquariums until it's safe to release them back into the wild.

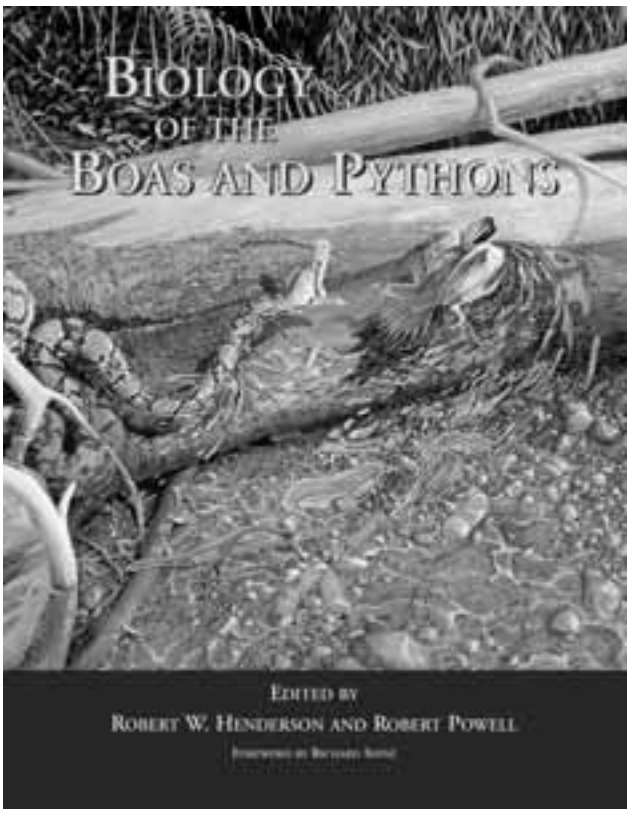
The Saint Louis Zoo, for example, has returned thousands of Puerto Rican Crested Toad (*Bufo lemur*) tadpoles to the pools of their homeland. We also are working in Ecuador to create a survival center in Quito, and we have teamed up with other zoos to create a survival center in rural Georgia for amphibians of North America. And right here, at one of the centers of the zoo's WildCare Institute, we are working to save Missouri's rapidly declining population of Hellbenders (*Cryptobranchus alleganiensis*).

In this struggle, time is short, and we need your awareness and support. Call us at the St. Louis Zoo, and we'll tell you how you can help.

BOOK REVIEW

A Bonanza of Boas and Pythons

Biology of the Boas and Pythons. 2007. Edited by Robert W. Henderson and Robert Powell. Eagle Mountain Publishing, LC, Eagle Mountain, Utah. x + 438 pp. Hardback – ISBN: 978-0-9720154-3-4. $100.00.



This sumptuous book is the result of a symposium entitled *Biology of Boas, Pythons, and Related Taxa* conducted at the 2005 joint meetings in Tampa, Florida, USA, and sponsored by the Society for the Study of Amphibians and Reptiles. This symposium represented the first effort to assemble researchers working on some aspect of the biology of boas and pythons.

An impressive and exquisitely produced volume, *Biology of the Boas and Pythons* (BBP) contains 29 chapters authored by 79 contributors. These chapters follow a Foreword by Richard Shine, in which he notes the paradoxical situation in which many laypeople envision a large boa or python when the word "snake" is mentioned, yet herpetologists have generally ignored these "spectacular" animals — until the present volume.

The main portion of the book is organized into five sections. The first section is the introduction, and the remaining four sections deal with "Ecology, Natural History, and Evolution," "Behavior," "Physiology, Neurology, and Reproductive Biology," and "Conservation." Thirty-four taxa of boas and pythons are addressed, with many chapters dealing largely with members of the genera *Python* (three chapters), *Boa* (six), and *Eunectes* (five).

The book's editors, the two Bobs, Henderson and Powell, wrote the book's masterful introduction, which provides a short summary of the book's contents, but mostly serves as a review of the literature on these basal macrostomatans prior to the 2005 symposium. This review is divided into a series of sections dealing with early publications on pythonid biology, various overviews of boid and pythonid biology, checklists of taxa, studies of basal macrostomatan phylogeny, and works on ecology and behavior, on morphology, physiology, and reproductive biology, and on conservation. Two tables and one appendix, all very useful, summarize the taxa of basal macrostomatans and the conservation status of a number of species. This chapter is graced with photographs of several herpetologists who study these creatures. The literature cited section is expectedly lengthy, containing 196 entries, five from 2006.

Instead of following the sections of the book, we have chosen to review the bulk of this volume from a taxonomic standpoint, grouping chapters dealing with the same taxon, which leaves us with a group of six chapters dealing with more than a single taxon. Five deal will multiple higher-level macrostomatan taxa. The first of these, by Nicolas Vidal and coauthors, addresses higher-level alethinophidian relationships, splitting this clade into two new entities, the Amerophidia, of hypothesized South American origin, which includes the families Aniliidae and Tropidophiidae, and the Afrophidia, of presumed African origin, which contains the remaining alethinophidians. They further hypothesize that this deep split is the result of the separation of South America from Africa in the mid-Cretaceous, which infers that the clade that contains almost all snakes, save for the amerophidians and the scolecophidians, had its origin on the emerging African continent. The authors acknowledge that the "phylogenetic status of 'Henophidia' (all Afrophidia, excluding Caenophidia) remains uncertain." A second such chapter, by Pizzatto and coauthors, addresses the evolution of ecomorphology in boine snakes, primarily of South America. By comparing morphological features (body size and shape) and macrohabitat use (arboreal to terrestrial to aquatic) to the two most complete boine phylogenies of Kluge and Burbrink, the authors hypothesize that the ancestral boine was a stout, short-tailed snake of moderate head length, but note that further characterizations differ between character optimizations based on morphology and those based on molecular data. Grace and Matsushita examine the interplay between vision and infrared imaging in guiding complex behavior in boas and pythons and concluded that infrared-imaging systems can be used alone to target prey, but almost certainly function in conjunction with vision when visible light is available. Other possible uses of infrared imaging in boas and pythons, such as predator avoidance, defense, and loca-

tion of refugia, are almost completely unstudied in these snakes. Goris et al. begin their summary of current knowledge of the anatomy and physiology of infrared imaging in snakes with a frank discussion of the stumbling blocks involved in their research. Their summary indicates that facial pits in snakes "appear to represent an ideal form of infrared eye." Finally, Ott and Secor studied the specific dynamic action (SDA), the amount of energy involved in the processing of a meal, in four species of boas and fours species of pythons. They demonstrated that SDA responses vary according to differences in meal size, meal type, body temperature, body size, and, perhaps, with type of foraging behavior, i.e., ambush foraging versus active foraging.

This book also has something for those interested in aspects of the anatomy, mechanics, and physiology of feeding and constriction in boas and pythons. Cundall and coworkers studied aspects of the biomechanics of feeding in 15 species of boas and pythons in nine genera through a series of recorded feeding trials. In this exemplary study, the authors identify three patterns of strike kinematics evident in boids, which can be preliminarily associated with the phylogenetic patterns evident at the subfamilial level. Secor and Ott explore the adaptive regulation of digestive function and intestinal physiology in boas and pythons, and the correlation between feeding habits and digestive performance. In a chapter measuring and comparing the constriction strength in 12 species of snakes, including eight boas and pythons and one tropidophiid, Moon and Mehta demonstrate that snake diameter and the number of coils employed in constriction strongly influence the pressure exerted during constriction, and that the crushing power employed by many species is enough to kill many prey items by crushing the spinal cord or stopping the heart, rather than by suffocation alone.

No single species is as well represented in this volume as *Boa constrictor*, with six chapters devoted entirely or almost entirely to this widespread Neotropical boa. While *Boa constrictor* is currently considered a single widespread species, the variation demonstrated by this large snake across its range is apparent in the breadth of its coverage in the volume. Two chapters are devoted to insular populations of *Boa* in Central America, including Boback and Carpenter's study of the ecomorphology of boas from islands off Belize. While insular *Boa* populations are well known for generally being much smaller than their mainland conspecifics, Belizean island boas also have longer heads and larger eyes, traits apparently inherited in this population. Reed and coworkers provide an assessment of the microhabitat, distribution, and conservation of another dwarf island race of *Boa*, from Cayos Cochinos, Honduras, and indicate that initial population size estimates for these small islands are alarmingly low. These boas, called "Hog Island Boas" in the live animal trade, have been and continue to be heavily exploited since at least 1979, yet this volume presents the first detailed study of this species in its natural habitat. This is one of the strengths of BBP, providing well-researched data on wild populations of species that are among the most heavily exploited snakes in the pet trade and simultaneously among the most poorly known snakes in their native environs. Two complementary chapters deal with the Argentine Boa Constrictor (*Boa constrictor occidentalis*): Chiaraviglio and Bertona's contribution examines factors influencing the ecological distribution of this subspecies, whereas Cardozo and coworkers use landscape modeling and population-level genetic markers to elucidate the effects of habitat loss and fragmentation on gene flow. These studies have important implications for the conservation of *Boa constrictor* in the wild, as does Holtzman and coworkers' chapter on the movement patterns and microhabitat selection of experimentally displaced boas in Nicaragua, which were shown to move more frequently and over greater distances than resident boas.

The widespread popularity of *Boa constrictor* and other large snakes in the pet trade has had negative impacts other than overexploitation of wild populations, as exemplified by the final chapter in the book, by Snow and coworkers. In this chapter, the distribution and ecological impact (existing and potential) of introduced populations of *Boa* and the Burmese Python (*Python molurus bivittatus*) in southern Florida are revealed. While the established *Boa* population seems restricted to a relatively small natural area along Biscayne Bay that is surrounded by suburban development, *Python molurus bivittatus*, which can readily exceed 4 m in length, is now well-established and reproducing throughout Everglades National Park. The impact of such a large predator in the Everglades is demonstrated by interactions between pythons and native alligators (*Alligator mississippiensis*), illustrated in three dramatic color photographs.

Two other chapters deal with species of *Python*, and both serve to further enlighten us about the natural history of heavily exploited pet-trade species. Perhaps the most popular of all pet boas or pythons is the Ball or Royal Python (*Python regius*), and a comprehensive ecological study of this species and the syntopic Central African Rock Python (*Python sebae*) in the Niger Delta, Nigeria, is provided by Luiselli and coworkers, and represents one of the most complete studies on wild populations of these two species. A chapter on the thermal biology of the Southern Rock Python (*Python natalensis*), formerly considered a subspecies of *Python sebae*, by Alexander is another data-rich and detailed analysis of a poorly known taxon, this time using modeling and field studies to evaluate the distribution of *P. natalensis* in relation to its thermal requirements.

A couple of contributions deal with habitat utilization of Caribbean boids in the genera *Corallus* and *Epicrates*. Sylvia

PETER J. TOLSON

Epicrates monensis occurs on the Puerto Rico Bank and on Isla Mona. This small, largely arboreal boid is listed in Appendix I of CITES. *Epicrates m. monensis*, such as this subadult emerging from a bromeliad (*Tillandsia utriculata*), is endemic to Isla Mona.

Powell and coworkers examine habitat utilization of two Caribbean treeboas, *Corallus cookii* and *C. grenadensis*, and indicate that treeboas are more commonly encountered in orchards and other disturbed habitats that contained edge microhabitats than in higher elevation "pristine" habitats that had few or no edges. Tolson and coworkers provide our first look at habitat use and natural history in one of the most poorly known extant members of the genus *Epicrates*, *E. monensis monensis*, which is endemic to the small limestone island of Mona in the strait between Hispaniola and Puerto Rico. These boas appear to be habitat generalists on their xeric island, but larger individuals tend to be found only among limestone boulders or high in the canopy. All three of these Caribbean boids are under threat from habitat disturbance and destruction, as well as introduced species like the mongoose, feral goats, and feral pigs. These contributions represent important additions to the body of data available to influence the conservation and management of remaining critical habitat.

Five chapters are concerned with features of the biology of two of the four species of *Eunectes*. Two chapters deal with *E. murinus* and three with *E. notaeus*. Rivas et al. examined the natural history of *E. murinus* in the Venezuelan Llanos. In what is one of the significant chapters in this volume, these authors note the need to consider natural history to be "good science," especially for the purposes of conservation and sustainable management, but that funding agencies may not support work that does not involve easily formulated and quickly testable questions. They also note that funding support may depend on such nonbiological features as the degree of "charisma" of the research subject. Four of these authors also studied sexual size dimorphism and the mating system of this species, demonstrating that females are more than 4.5 times the size of the males, one of the largest sexual size differences known, and that prolonged breeding-ball polyandry is the principal mating system. Young demonstrated that *E. notaeus* responds to aquatic acoustic stimuli, allowing snakes to locate prey swimming on the surface. Waller et al. studied the conservation biology of *E. notaeus* in northeastern Argentina, in an area where this snake is heavily exploited for the skin trade. They concluded that due to biological trait plasticity, habitat inaccessibility, and rudimentary local hunting methods, this species is capable of being sustainably managed. Finally, Mendez et al. investigated the management implications of the genetic population structure of *E. notaeus*, concluding that demonstrated genetic isolation of Yellow Anaconda populations in northern Argentina require these populations to be treated as distinct management units.

One chapter each deals with some aspects of the biology of *Charina*, *Liasis*, and *Ungaliophis* and two chapters deal with species of *Morelia*. Dorcas and Peterson tested the coadaptive relationship between thermoregulatory behavior and thermal physiology in *Charina bottae*, and found that a tight relationship between the two cannot be applied to this snake. Carmichael et al. examined geographic variation in pheromone-trailing behaviors among island populations of *Liasis mackloti*, concluding that pheromone-trailing discrimination parallels the relationships demonstrated by morphological and genetic means, and supports the recognition of three clades. Burger and Ford examined aspects of the reproductive biology of poorly-known *Ungaliophis continentalis*, finding that males use two distinct types of courtship behavior, one passive and the other assertive. The latter, which involves continuous tail-biting, is unique to the species. When combined with coiling, it allows males to adjust their behavior for successful copulation through sexual coercion. Wilson investigated the foraging ecology and diet of *M. viridis*, a sit-and-wait ambush predator. This species is largely arboreal and adopts either a feeding or resting posture in sites that can be maintained for up to 14 days, making it possible to time-lapse videotape radiotelemetered individuals. Wilson determined that this species' foraging behavior and diet are affected by both ontogeny and sexual differences. As such, they demonstrate "an ontogenetic change in their diet from invertebrates and diurnal skinks to primarily nocturnal mammals as they increase in size. This dietary change happens in conjunction with a change in hunting time from primarily diurnal to nocturnal and an ontogenetic color change from yellow to green." Freeman and Bruce studied habitat use in two species of *Morelia* (*M. kinghorni* and *M. spilota*) in North Queensland, Australia, using data derived largely from roadkills. By this means, they demonstrated that *M. kinghorni* is primarily restricted to closed rainforest habitats, where they use large epiphytic ferns for basking, and is no longer found in cleared rainforest locales. In contrast, *M. spilota* is commonly found in cleared/mosaic areas, including agricultural and urban areas. For differing reasons, neither of these snakes is considered currently in danger of extirpation.

This book is a hugely important contribution to our burgeoning knowledge of the biology of this fascinating group of diverse, beautiful, and phylogenetically significant basal snakes. It takes its rightful place alongside the earlier compendia on the biology of pitvipers and vipers in general, also available through Eagle Mountain Publishing. In a number of ways, this volume actually stands ahead of its brethren. It is full-color throughout (with more than 200 color images) and the layout and production values are impressive, attesting to the skills of its editors and publisher. This book is a classic out of the gate. This is also a book that cries out for a sequel, so we can hope the editors and publisher will consider such for the near future. Any herpetologist will be seriously embarrassed if this book is not on the shelves of his or her library. Instead of filling up the gas tank two or three times, we recommend buying this book, curling up under a reading lamp in your favorite chair, accompanied by something soothing, and learning about the biology of some of these really nice animals. Better options may exist, but we have forgotten how … and why.

Larry David Wilson
Department of Biology
Miami Dade College
Kendall Campus
Miami, Florida 33176

and

Josiah H. Townsend
School of Natural Resources and Environment
and Florida Museum of Natural History
University of Florida
Gainesville, Florida 32601

CONSERVATION RESEARCH REPORTS

Conservation of the Indonesian Herpetofauna

Indonesia is an archipelagic nation composed of some 17,000 islands of varying sizes and geological origins, and with marked differences in flora and fauna. Indonesia is considered one of the Earth's megadiversity centers. According to the Biodiversity Action Plan for Indonesia, 16% of all amphibian and reptilian species occur in Indonesia, a total of over 1,100 species. New research activities, launched in the last few years, indicate that these figures may be significantly higher than generally assumed. Herpetological research in Indonesia, however, has not progressed at a rate comparable to that of neighboring countries. In the last 70 years, 762 new taxa have been described from southeastern Asia, of which only 262 were from Indonesia. In general, the herpetofauna of Indonesia is poorly understood compared to the herpetofauna of neighboring countries. Moreover, geographic distribution patterns for many species are poorly known. In view of the alarming rate of forest loss, measures for more effective protection of the herpetofauna of Indonesia are urgently required. The IUCN Red List status of virtually all Indonesian species remains unknown, and no action plans have been formulated. ISKANDAR AND ERDELEN (2006. *Amphibian and Reptile Conservation* 4:60–87) provided an overview of the herpetofauna as part of Indonesia's biodiversity, outlined the history of herpetological research in the region, and identified major gaps in our knowledge of the Indonesian herpetofauna. The latter addressed the contents and shortcomings of compilations of lists of protected or threatened species by national and international authorities and major threats to the Indonesian herpetofauna, and proposed measures for better long-term conservation.

CHRIS TABAKA, DVM

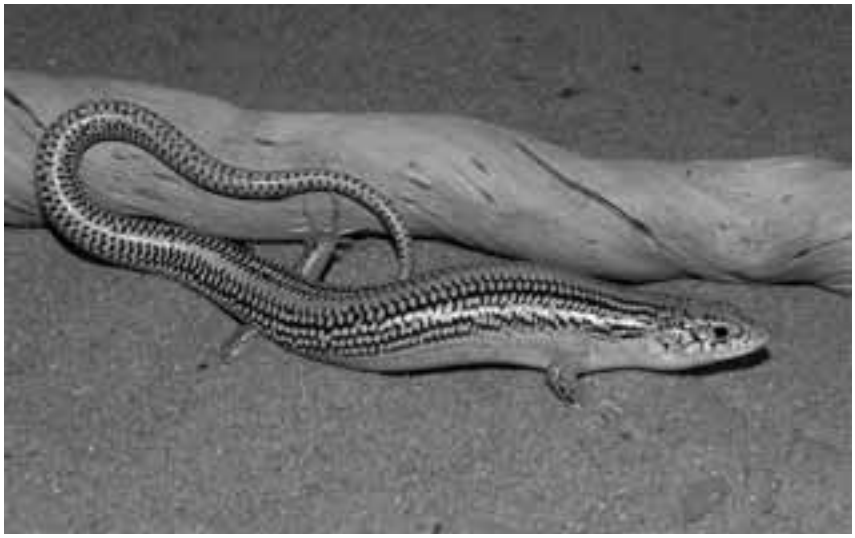
The endangered Giant River Terrapin (*Batagur baska*) is one of many Indonesian reptiles about which very little is known.

Rangeland Management and a Tallgrass Prairie Herpetofauna

The Flint Hills of Kansas and Oklahoma have changed dramatically in the past 30 years, largely due to conversion from natural tallgrass prairie to cattle rangeland. Because the effects of fire and grazing on the herpetofauna are poorly understood, WILGERS ET AL. (2006. *Herpetologica* 62:378–388) examined how different land management practices, such as cattle stocking rates and seasonal burning, affected amphibians and reptiles. Fourteen herpetofaunal surveys documented the number of individuals, environmental conditions, and community dynamics, including the probabilities of local extinction or permanent emigration. Land-use practices during the study were traditional season-long stocking during the first 10 years, burning pastures in alternate years. In 1999, land management practice changed to intensive early cattle stocking, combined with annual burning. Data suggested that burn frequencies and cattle stocking affected the herpetofauna, with rates of species loss higher during years of burning than in non-burn years.

Forest Fragmentation and Community Structure in Costa Rica

Habitat fragmentation is one of the most serious threats to biodiversity. The increasing conversion of land to agricultural uses in Costa Rica has greatly reduced forested area, and has more than doubled the number of forest fragments in some areas. Reptiles and amphibians occur at high densities in the Neotropics, but we know little about their responses to land-use changes. BELL AND DONNELLY (2006. *Conservation Biology* 20:1750–1760) examined community and population structure of frogs and lizards in the fragmented landscape surrounding La Selva Biological Station, Costa Rica to better understand the effects of forest fragmentation. Nine fragments, ranging in area from 1–7 ha, were compared to an 1,100-ha area in the preserve. Community structure of frogs and lizards in forest fragments differed significantly from that of the intact forest community. Lizard density was higher and frog density was lower in forest fragments than in continuous forest, and 25% of species found in continuous forest were not observed in fragmented forest. Species composition and relative abundance varied among sites according to fragment size. The extent of isolation and habitat variables did not affect species richness, composition, or nesting. The authors concluded that small populations



SUZANNE L. COLLINS, CNAH

The Great Plains Skink (*Eumeces obsoletus*) is one of many prairie-dwelling species affected by land management practices.

GAD PERRY

Costa Rican lizards, such as this Black Iguana (*Ctenosaura similis*), which benefit from breaks in forest canopies that provide effective basking sites, often increase in numbers in response to forest fragmentation.

are threatened by edge effects, and that preservation of large reserves is crucial for the preservation of reptiles and amphibians in La Selva and in other fragmented habitats.

The Pigeon Paradox

Conservation of urban nature is rarely discussed, yet, as ecosystems continue to shrink and change due to urbanization, conservation will increasingly rely on urban habitats to preserve natural communities. DUNN ET AL. (2006. *Conservation Biology* 20:1814–1816) refer to this phenomenon as the "pigeon paradox." Based on assertions that current conservation action is insufficient, people are more likely to take conservation action when they have direct experiences with the natural world, and humans in the future will experience nature primarily through contact with urban wildlife, the authors concluded that providing opportunities for children living in cities to experience nature is essential, as the future of conservation will depend largely on the urban culture. To meet this need, societies must restore urban ecosystems, improve access to urban nature, and carefully consider the costs and benefits linked to how we portray non-native and "pestiferous" urban species (such as "pigeons").

Climate Change and Herpetofaunal Declines

ARAÚJO ET AL. (2006. *Journal of Biogeography* 33:1712–1728) explored the relationship between current European distributions of amphibian and reptilian species and potential impacts of climatic warming by asking what proportion of species are projected to lose and gain suitable climate space; whether species projections vary according to taxonomic, spatial, or environmental properties; and what climate factors might be driving projections of loss or gain in suitable environments. Distributions were projected into the future using five climate-change scenarios for 2050, and projections were made according to two extreme assumptions: species have unlimited dispersal ability or species have no dispersal ability. Many species were projected to expand distributions if dispersal is unlimited, mainly because warming in the cooler northern ranges of species creates new opportunities for colonization. If species are unable to disperse, then most species were projected to lose range, mainly in southwestern Europe, where dry conditions were projected to increase. The authors suggested that the impact of increasing temperatures on amphibian and reptilian species might be less deleterious than previously postulated. However, the ability of species to cope with climatic warming may be offset by projected decreases in the availability of water, particularly for amphibians. Limited dispersal ability may further increase the vulnerability of amphibians and reptiles to changes in climate.

GUNTHER KÖHLER

Many European reptiles, such as this Slow Worm (*Anguis fragilis*) are expected to expand their ranges in response to global warming.

Island Differences in Komodo Dragons

Species inhabiting archipelagos are often characterized by high levels of interpopulation divergence (e.g., size-related traits). This divergence may, in turn, influence life history. To facilitate better management and conservation of the Komodo Dragon (*Varanus komodoensis*), JESSOP ET AL. (2007. *Biological Conservation* 135:247–255) identified demographic differences between two island populations in Komodo National Park, Indonesia. Comparison of data collected from dragon populations inhabiting Rinca Island and the much smaller Gili Motang Island indicated that between 1994 and 2004, the Komodo Dragon population on Gili Motang significantly decreased its mean body mass, body condition, and relative abundance. These results suggest that the numerically small Gili Motang population was oscillating downward; in contrast, the Rinca Island population had been relatively stable. These results emphasize the necessity for managers of this priority conservation species to understand further the inherent functional differences among dragon populations to develop island-specific management units. Current management practices instigated by Komodo National Park management ignore small-

ALBERTO LOPEZ

Green Iguanas (*Iguana iguana*) are common urban species both where the species is native and in areas, such as southern Florida, where it has been introduced.

JOE WASILEWSKI

Demographic differences between two island populations of Komodo Dragons (*Varanus komodoensis*) in Komodo National Park, Indonesia emphasize the necessity for managers of this priority conservation species to develop island-specific management units.

island dragon populations and thus run the risk of being unable to detect adverse effects for populations that are potentially most prone to decline.

Dim Future for Fiji's Endemic Crested Iguana

The Fijian Crested Iguana (*Brachylophus vitiensis*) was not described until 1981, but it appears to be secure on only one small island sanctuary. HARLOW ET AL. (2007. *Oryx* 41:44–50) surveyed 17 islands in western Fiji with historical records of Crested Iguanas, and found that iguanas were "extremely rare or extinct" on all of those islands. Iguanas were recorded on four of the surveyed islands, but the authors suggested that all of these populations are small and continuing to decline, primarily due to ongoing forest habitat destruction by fire and goat grazing and the introduction of feral cats. Most distressing were the repeated surveys of the cat-free, uninhabited island of Monuriki, where a population estimate of 40–80 iguanas in 1998 had decreased by a factor of four in 2003 — so low that an estimate was no longer possible. The authors indicated that these data should spur the government of Fiji to instigate immediate conservation action on behalf of the nation's most famous wildlife icon.

Effects of Agricultural Practices on Wood Turtles

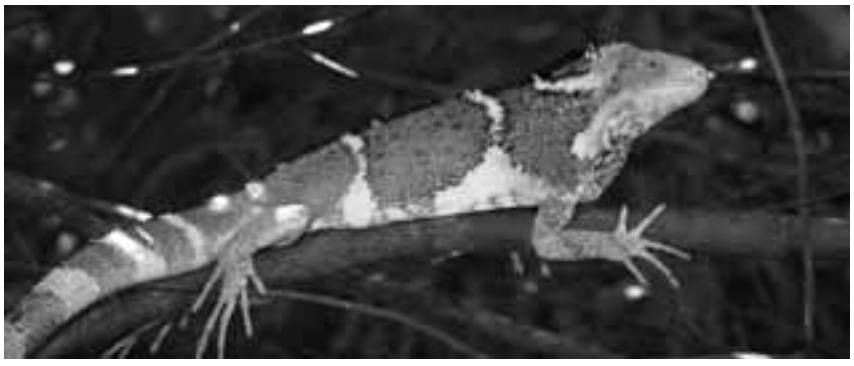
In North America, the spatio-temporal scale of deforestation has resulted in a 94% decrease in temperate forests within 360 years. Despite the enormous scale of this disturbance, agriculture is so pervasive in modern society that its impacts are highly underappreciated. SAUMURE ET AL. (2007. *Biological Conservation* 135:581–591) investigated the impact of current agricultural practices on a disturbance-dependent species in southern Québec, Canada. Of 30 Wood Turtles (*Glyptemys insculpta*) followed via radiotelemetry, 20% died as a result of agricultural activities. Anthropogenic mortality estimates for adults and juveniles in 1998 were 0.10 and 0.18, respectively. For 1999, these values were 0.13 and 0.17, respectively. Of those turtles that survived, many had injuries inflicted by agricultural machinery. Sub-lethal mutilation rates for adults were 90 ± 3% in both years, whereas the maximum frequency for juveniles was 57%. The cutting height of disc mowers increased to 100 mm increases harvest yields, reduces wear on machinery, and decreases soil erosion. A by-product of such a change in cutting height is that turtle mortality and injury rates should be reduced, as Wood Turtle carapace height is < 87 mm. Without changes in agricultural practices, this population will be extirpated.

SUZANNE L. COLLINS, CNAH

Wood Turtles (*Glyptemys insculpta*) are vulnerable to common agricultural practices.

Conserving New Zealand's Diurnal Geckos

Visually cryptic, long-lived, diurnal Green Geckos (*Naultinus*) were a significant component of natural ecosystems throughout much of New Zealand prior to human settlement about 1800 years ago. Since then, habitat modification and introduced mammalian predators have threatened many populations, making their survival a conservation priority. HARE ET AL. (2007. *Journal of Herpetology* 41:81–93) pooled data collected over a 25-year period on the population of *N. manukanus* on mammal-free Stephens Island and determined that it is female-biased (1:1.7), a trend evident from birth, that sexual maturity occurs at approximately four years of age, and that 71% of females reproduce annually. These geckos are strictly diurnal, arboreal, and opportunistic thermoregulators. Movements are limited, averaging 0.6 m per day, characteristic of a sit-and-wait foraging strategy. These data provide a context for developing conservation management plans for increasingly threatened populations of geckos in the genus *Naultinus*.



PETER S. HARLOW

Populations of the Fijian Crested Iguana (*Brachylophus vitiensis*) were found on only four of 17 islands in western Fiji on which iguanas had been documented in the past.

JENNIFER GERMANO

Marlborough Green Geckos (*Naultinus manukanus*) on mammal-free Stephens Island off New Zealand are visually cryptic, long-lived, strictly diurnal, arboreal, and opportunistic thermoregulators.

NATURAL HISTORY RESEARCH REPORTS

MINISTERIO DE EDUCACION Y CIENCIA DE ESPAÑA

Female Iberian Wall Lizards (*Podarcis hispanica*) might base their mate choice on male "quality" as indicated by the composition of their chemical signals.

Asian Snake Stores Toad Toxins

The Asian snake *Rhabdophis tigrinus* possesses specialized defensive glands on its neck that contain steroidal toxins known as bufadienolides. **HUTCHISON ET AL.** (2007. *Proceedings of the National Academy of Sciences of the United States of America* 104:2265–2270) hypothesized that *R. tigrinus* does not synthesize these defensive steroids, but instead sequesters the toxins from toads it consumes as prey. To test this hypothesis, the authors conducted chemical analyses on the glandular fluid from snakes collected in toad-free and toad-present localities and performed feeding experiments in which hatchling *R. tigrinus* were reared on controlled diets that either included or lacked toads. They demonstrated that the cardiotonic steroids in the nuchal glands of *R. tigrinus* are obtained from dietary toads. Hatchling snakes had bufadienolides in their nuchal glands only if they were fed toads or were born to a dam with high concentrations of these compounds. Because geographic patterns in the availability of toxic prey are reflected in the chemical composition of the glandular fluid, snakes in toad-free regions are left undefended by steroidal toxins. The ability to sequester dietary toxins underlies geographic variation in antipredatory behavior in this species.

NIK BROUNTAS, HTTP://GDIMENSION.TYPEPAD.COM

Hatchling Asian Grass Snakes (*Rhabdophis tigrinus*) have toxins in specialized defensive glands only if they consume toads or were born to a dam with high concentrations of poisonous compounds.

Male Scents Signal a Better Immune System

Despite the importance of chemoreception in sexual selection of lizards, few studies have examined the composition of chemical signals, and whether and how chemicals provide honest information is unknown. Chemical signals might be honest if they indicated a trade-off between sexual advertisement and the immune system. **LÓPEZ AND MARTÍN** (2005. *Biology Letters* 1:404–406) showed that proportions of cholesta-5,7-dien-3-ol in femoral secretions of male Iberian Wall Lizards (*Podarcis hispanica*) were related to their T-cell-mediated immune response. Thus, only males with a good immune system may allocate higher amounts of this chemical to signaling. Furthermore, females selected scents of males with higher proportions of cholesta-5,7-dien-3-ol and lower proportions of cholesterol. Thus, females might base their mate choice on the males' quality as indicated by the composition of their chemical signals.

Lizards "Shout" in Noisy Habitats

Many acoustically communicating animals compensate for background noise by using acoustic properties that enhance the transmission of vocalizations in noisy habitats. **ORD ET AL.** (2007. *Proceedings of the Royal Society B: Biological Sciences* 274:1057–1062) showed that visual noise from windblown vegetation has an equally important influence on the production of dynamic visual displays. They found that two species of Puerto Rican lizards, *Anolis cristatellus* and *A. gundlachi*, increase the speed of body movements used in territorial signaling to improve communication in visually "noisy" environments of rapidly moving

vegetation. Together with previous work on acoustic communication, these data show that animals with very different sensory ecologies can face similar environmental constraints and adopt remarkably similar strategies to overcome those constraints.

ROBERT POWELL

Puerto Rican Crested Anoles (*Anolis cristatellus*) increase the speed of body movements used in territorial signaling to improve communication in visually "noisy" environments.

ROBERT POWELL

Populations of larger St. Vincent Dwarf Geckos (*Sphaerodactylus vincenti*) living in more mesic environments at higher elevations are less resistant to water loss.

Natural History of St. Vincent Dwarf Geckos

STEINBERG ET AL. (2007. *Journal of Herpetology* 41:326–332) documented population densities, microhabitat preferences, desiccation rates, and diets of *Sphaerodactylus vincenti* on St. Vincent, West Indies. The authors predicted and observed high densities (to 5,625/ha) in moist, shaded leaf-litter. Such microhabitats provide refuges, access to prey, and protection against water loss, as *S. vincenti* is vulnerable to high desiccation rates. They found significant differences in mass-specific water-loss rates and body mass between conspecific populations at differing elevations, with larger geckos less resistant to water loss living in more mesic environments at higher elevations. Stomach content analysis suggests that *S. vincenti* is a dietary generalist that feeds on a variety of small arthropods primarily by day.

NEWSBRIEFS

Virgin births at the London Zoo

Four Komodo Dragons (*Varanus komodoensis*) hatched at the London Zoo were the result of parthenogenesis, the development of an egg without fertilization by a sperm. A clutch of dragon eggs laid in August 2005 fascinated reptile keepers. The female had arrived in London on loan from Thoiry Zoo in France in early 2005, and the clutch of eggs was laid more than two years after she had last lived with Thoiry's male. Initially, keepers suspected sperm storage, but Curator of Herpetology, Richard Gibson, wasn't entirely convinced and resolved to investigate further.

Genetic fingerprinting techniques at Liverpool University confirmed that the four dragons were actually the result of parthenogenesis. The female later mated with the London Zoo's male and subsequently laid a second clutch of eggs from which a single, "normal" dragon hatched, demonstrating that Komodo Dragons can switch reproductive strategies depending on the availability of a mate.

Richard Gibson said: "I am delighted that the mysterious parentage of our Komodo Dragon babies has been solved, and that we have discovered something new to science at the same time. Knowing that the world's largest lizard can reproduce like this suggests that many other reptiles may also do this more often than we thought, and may lead to changes in the way we manage this and other species in breeding programs. This discovery also raises important questions about the natural history of dragons in the wild, and will therefore help to safeguard the future of the species."

TROOPER WALSH, NATIONAL ZOOLOGICAL PARK

Four Komodo Dragons (*Varanus komodoensis*) hatched at the London Zoo were the result of parthenogenesis, the development of an egg without fertilization by a sperm.

Zoological Society of London
21 December 2006

Homing Behavior in Baby Snakes

We all know that children behave like their parents in many ways, especially as they grow older (even though many children deny it!) — and most of us suspect that the similarity is partly due to learning, and not just genetics.

Researchers from the University of Sydney have discovered that baby snakes also behave like their parents, and probably for similar reasons as in humans. For more than a decade, Drs. Greg Brown and Rick Shine have been studying the ecology of small non-venomous Keelback Snakes (*Tropidonophis mairii*) on the floodplain of the Adelaide River, on the outskirts of Kakadu National Park in the Northern Territory.


GREG CALVERT, © JAMES COOK UNIVERSITY

Female Australian Keelback Snakes (*Tropidonophis mairii*) return to the same area where they were hatched. So, many snakes probably lay their own eggs in the same nest from which they themselves hatched.

One of their latest findings (just published in the journal *Biology Letters*) is that once they grow to adulthood and are ready to reproduce, female snakes return to the same area where they were hatched. So, many snakes probably lay their own eggs in the same nest as that from which they hatched, at least one year previously.

Professor Shine said: "One of the reasons that we behave like our parents is that our behavior is strongly molded by our early experiences — and we have found that the same thing happens in snakes as well. We have known for many years that baby salmon somehow recognize the characteristics of water from the streams where they hatch, and return to the same stream many years later to breed. We've found exactly the same thing in snakes. Even though a Keelback Snake wanders widely during the first year or two of her life, she returns to her original birthplace when it's time to lay her own eggs."

Why do snakes return to lay their eggs at the same place that their mothers did, years before? The answer is probably that the nest was a good one — otherwise no babies would survive to return. So, evolution has favored snakes that are able to remember where they hatched, and return there when the time comes to produce their own offspring.

These results have strong implications for conservation, because if successive generations of snakes use the same "traditional sites" for nesting, any disturbance to those sites could be a major problem. The research also tells us that these small creatures, with brains about the size of a pea, can remember the exact location of their birth site for many months or years, and find their way back when it's time to reproduce. Also, the discovery of "traditional knowledge" in snakes casts yet more doubt on the belief that culture belongs only to humans.

The University of Sydney
20 February 2007

Dogs Sterilized To Save Endangered Turtles

Stray dogs are being sterilized to protect many thousands of endangered Olive Ridley Sea Turtles (*Lepidochelys olivacea*) that nest on beaches in Orissa (India) every winter. Dogs destroy nests and kill many baby turtles each year. At least 22 dogs were sterilized over the weekend at the Devi River mouth, one of the three sites where the turtles come. Amala Akkineni, of the Hyderabad-based environmental group Blue Cross said: "One pair of dogs gives rise to 2,000 in their lifetime. The operation will reduce the number of dogs in these areas, reducing the future destruction of turtle nests."

Blue Cross is conducting the sterilization program in collaboration with the Department of Fisheries and Animal Resources Development and some NGOs. Said Amala: "We will sterilize at least 2,500 dogs in the next six months in all three nesting sites to save turtle eggs and hatchlings. We will also provide training to 15 veterinary doctors to carry out the task."

Until five years ago, the sea surrounded two tiny islands, where turtles come for mass nesting. As a result, no animal could reach the islands to destroy the eggs. At least half a million turtles lay eggs on these two islands. Since 2002, however, the islands have become accessible from the neighboring Wheeler Island due to erosion.

Animalconcerns.org
30 January 2007

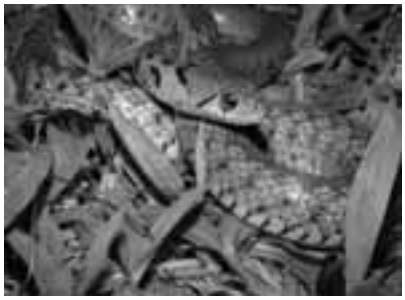

WWW.AMIGOSDOMARNAESCOLA.COM.BR/BANCODEIMAGENS.PHP

Stray dogs are being sterilized to protect many thousands of endangered Olive Ridley Sea Turtles (*Lepidochelys olivacea*) that nest on beaches in Orissa, India.

Snake Found in Hawaii

A worker at Hilo Harbor found and killed a Chequered Keelback Snake (*Xenochrophis piscator*), a species that is widely distributed in Asia and the East Indies. These non-venomous aquatic snakes are not usually considered to be pets. The carcass was flown to Oahu, where a specialist from the Bishop Museum identified the snake. Snakes are illegal in Hawaii, where no natural means of control occur and many native species are potentially vulnerable to introduced predators. Officials are concerned that invasive species can significantly hurt Hawaiian ecosystems.

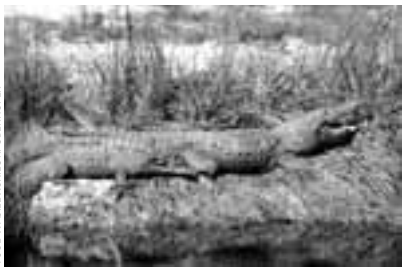
TheHawaiiChannel.com
30 January 2007



A Chequered Keelback Snake (*Xenochrophis piscator*), a species that is widely distributed in Asia and the East Indies, was found and killed in Hilo Harbor.

American Crocodile Downlisted by U.S. Government Reclassified from Endangered to Threatened

The U.S. Fish and Wildlife Service announced Tuesday that recovery efforts are making it possible to reclassify the American Crocodile (*Crocodylus acutus*) in Florida from endangered to threatened under the Endangered Species Act. "American Crocodiles were a part of Florida's history for hundreds of years until human activities such as urban development, agricultural conversion and overhunting decimated their populations," said Sam D. Hamilton, the service's southeast regional director. "However, in the past 30 years, we have made great strides in protecting this species and conserving its habitat. Today we can celebrate their comeback as a result of the recovery efforts by numerous dedicated professionals who are helping sustain a vital part of Florida's natural and cultural history."



AJOE WASILEWSKI/LORI OBERHOFER

The American Crocodile (*Crocodylus acutus*) in Florida is being reclassified from endangered to threatened under the Endangered Species Act.

The service's final reclassification decision comes after the completion of its five-year review required under the ESA for all endangered and threatened species. An endangered species is defined as being in danger of extinction within the foreseeable future. A threatened classification means a species could become endangered. Reclassifying a species from endangered to the less-critical threatened designation is often reflective of recovery efforts reducing imminent threats and allowing populations to increase.

The American Crocodile is being reclassified in southern Florida, its only habitat within the U.S. This crocodilian will remain endangered in other countries, including Belize, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Nicaragua, Mexico, Panama, Peru, and Venezuela. The American Crocodile in Florida was originally listed as an endangered species in 1975. Their numbers in Florida have grown to an estimated 1,400–2,000, not including hatchlings.

The species is one of two native crocodilians, the other being the American Alligator (*Alligator mississippiensis*), that are known to frequent the U.S. It can be distinguished from the American Alligator by a relatively narrow, more pointed snout and by an indentation in the upper jaw that leaves the fourth tooth of the lower jaw exposed when the mouth is closed. In order to reclassify the American Crocodile from endangered to threatened, the recovery plan requires a sustained breeding population of 60 females. About 95 percent of the remaining American Crocodile habitat in southern Florida has been acquired by federal, state, and county agencies. These protected areas should allow the population to expand and could provide additional nesting opportunities.

Miami, Florida

Herpetologists Honored for Contributions to Conservation

The Florida Chapter of The Wildlife Society (FLTWS) announced the winners of the first annual Paul Moler Herpetological Conservation Award. The recipients, Mark Bailey, Kurt Buhlmann, Jeff Holmes, and Joe Mitchell, were selected for producing the new Partners for Amphibian and Reptile Conservation publication, "Habitat Management Guidelines for Amphibians and Reptiles of the Southeastern United States." Featuring detailed, yet easy-to-understand ideas and methods to help landowners improve the conservation value of their land, the book has received excellent reviews from land managers and conservation professionals across the region. The Guidelines effectively cover the wide variety of habitats and the diverse herpetofauna of the southeastern United States, both with text and exquisite photography. The book is available to the public and can be ordered at www.parcplace.org.

The conservation award was presented during this year's annual meeting of the FLTWS, 11–13 April 2007, in St. Petersburg, Florida. The award was established in honor of one of Florida's preeminent herpetologists, Paul Moler, who retired in 2006 after 29 years of service with the Florida Fish and Wildlife Conservation Commission. "I am especially gratified to see this first Herpetological Conservation Award go to the authors of PARC's outstanding southeastern Habitat Management Guidelines," Moler said upon hearing the announcement. The FLTWS is made up of over 300 wildlife professionals dedicated to sustainable management of wildlife resources and their habitats in Florida. For more information about the society, visit www.fltws.org.

Dinosaurs and Birds

A few years ago, Michael Crichton wrote a highly successful and purely speculative book titled *Jurassic Park* about extracting DNA from dinosaurs. Both the book and the subsequent movie were huge successes. Now, Crichton's imagination has become reality (although, thankfully, not the recreation of living animals using frog-DNA splices).

Scientists have long considered birds to be the closest living relatives of dinosaurs. This was based on bone characteristics, because no soft tissue had survived to confirm the link. Now, protein extracted from a 68-million-year-old *Tyrannosaurus rex* has provided convincing data. "It's the first molecular evidence of this link between birds and dinosaurs," said John Asara, a Harvard Medical School researcher, whose results were published in the journal *Science*.

In 2005, Mary Higby Schweitzer of North Carolina State University found blood vessels and cells in a *T. rex* bone from the fossil-rich Hell Creek Formation in Montana. In another *Science* article, Schweitzer reported that extracts of that bone reacted with antibodies to chicken collagen, suggesting the presence of birdlike proteins in dinosaurs.

PALAIS DE LA DÉCOUVERTE, PARIS

The paleontologist Robert T. Bakker once referred to *Tyrannosaurus rex* as a "thunder-chicken from hell." New evidence provides strong support for his once controversial ideas.

OBITUARY

Hymen Marx
(1925–2007)

Hymen Marx, Curator Emeritus at the Field Museum of Natural History in Chicago, Illinois, died on 25 January 2007 in Sun City, Arizona. During his 42 years at the Field Museum, Hy contributed much to the field of herpetology through his own research and through his unique, lively, and supportive personality.

Hymen "Hy" Marx was born 27 June 1925 in Chicago, Illinois. He lived in the Chicago area until his move to Arizona in the early 1990s. His father, Phillip Marx, was a butcher and his mother, Minnie Serota Marx, was a homemaker. Hy was drafted into the U.S. Air Force in 1943. He served as a radar mechanic and was stationed in the U.K., where he worked on a ground crew of the 8th Air Force maintaining the radar systems of the famous "Flying Fortresses." Like so many others, Hy went back to school in 1945 under the G.I. Bill and graduated in 1949 from Roosevelt University with a B.S. degree and a major in biology. That marked the end of Hy's formal education, and from then on he depended on colleagues and his own intellectual curiosity to fuel his career development. In Hy's case — and to his great credit — that was enough. While in school, Hy met Audrey Elaine Greene and they married in 1950 and had two children.

In 1948, while he was a student at Roosevelt University, Hy began volunteering in the Division of Amphibians and Reptiles, working as an assistant to Karl P. Schmidt. Hy referred to Clifford H. Pope and "K. P." Schmidt as his "academic papas." Hy joined the Division in 1950 as its first full-time assistant. For the next ten years, he served as "Collection Manager," and oversaw the collection through significant growth and reorganization, including a major move from the third floor to the ground floor in 1952–53. This period of intensive collection growth was marked by the arrival, in 1954, of 35 five-gallon milk cans containing 77,000 frogs and toads that were sent by the Institut des Parcs Nationaux de Congo Belge to Karl Schmidt for identification. This huge shipment almost matched the number of specimens (85,000) in the entire collection at the time, and a significant number of these specimens were deposited at the Field (Bauer 1954). This period also was marked by the Division's single most significant purchase, that of the Edward Harrison Taylor collection of 35,000 specimens, which was accessioned beginning in 1959. That collection, which is extensively cited in the herpetological literature, includes many type specimens, caecilians, and skeletons. Its geographic strengths include Mexico, Costa Rica, Liberia, Sri Lanka, and Thailand. During these ten years, Hy also published 16 papers, which led to his promotion to the curatorial ranks. He was promoted to full curator in 1973.

For roughly 40 years, Hy's career at Field Museum overlapped with that of Robert (Bob) F. Inger. Hy and Bob collaborated on several publications, but the most notable was their monograph on the snakes of the colubrid genus *Calamaria* (Inger and Marx 1965). This monograph embraced many of the newest methods and approaches of that time and it remains a landmark work on that group of snakes today.

In addition, Marx's research interests also included the herpetofauna of Egypt, the systematics and zoogeography of the vipers, the phyletics of morphological characters, the application of phyletic character analysis to convergent snake species, and the application of Sharrock and Felsenstein's combinatorial method to phylogenetic studies. To facilitate his NSF-supported collaborative research with George Rabb, over five hundred snake skulls were removed from preserved specimens and prepared for character analysis. These skulls, comprising over 235 genera, form a subset of the osteological collection that is well used by researchers. This work resulted in their "50 characters volume" (Marx and Rabb 1972) that still is of great practical use to students of squamate systematics.

Following this time, one of us (HKV), had the privilege of collaborating with George Rabb and Hy on a project involving character analysis (Marx, Rabb, and Voris 1977). During the two years that we worked on this project, the three of us had many stimulating and heated discussions. Those readers who knew Hy will understand us when we say that Hy provided us with plenty of aggravation and entertainment. He often referred to his two co-workers, not as his esteemed collaborators, but rather as his "close enemies."

Hy's research interests were varied, but the subject that interested him most was the evolution of venomous snakes in the family Viperidae. But Hy did not fit any stereotype of a dusty, dry museum curator — if you met Hy, even briefly, you immediately learned that he was exceptionally gregarious! This was true in both his personal and professional life. In his professional life, this took the form that most of us call collaborations,

Hymen Marx releasing a male Common Basilisk (*Basiliscus basiliscus*) prior to determining its running speed (photograph © 1966, courtesy of The Field Museum. Z89606).

Hymen Marx holding a preserved specimen of the common European Viper (*Vipera berus*) that was cataloged as FMNH 200,000 in September 1975 (photograph © 1975, courtesy of The Field Museum. GN82282).

but Hy referred to it as "sharing our sandbox." He was a great collaborator, but this activity was not for the weak of heart! He was sharp, witty, insightful, and prone to wander far off the subject. A lively discussion might initially address the shape of the dentary bone in the Gaboon Viper (*Bitis gabonica*) and then inexplicably shift to Hy providing a review of "Sleeper," Woody Allen's latest movie at the time. This was vintage Hy Marx. No collaborator could expect to evade one of Hy's practical jokes — that was the cost of doing business. Karel Liem, Henry Bryant, Bigelow Professor of Ichthyology at Harvard University, and George Rabb, now President Emeritus of the Chicago Zoological Society, and several others know this only too well!

Hy contributed greatly to the academic and administrative life at Field Museum. He served as the Head of the Division of Amphibians and Reptiles from 1970–79, and from 1985–90, and over the years served on more than 20 Museum committees. Hy fully understood the importance of encouraging young people in their interests, and for that reason, he was an active contributor to Members' Nights at the Museum, when doors were opened for members to view the work that goes on "behind the scenes." Hy also had many unofficial roles at the Museum, and he served as a sort of social guru to the entire staff. In this regard, Hy referred to himself as a "social butterfly," and enjoyed organizing both intellectual discussions on character analysis as well as recruiting teams and scheduling times for doubles tennis matches.

During Hy's 40 years of service at Field Museum, he also served on the Committee on Evolutionary Biology at the University of Chicago. In this capacity, he did not teach formal classes, but rather he informally guided both master's and doctoral degree students in their research programs. On this, one of us (HKV) can speak from first-hand experience. Hy helped me choose a Ph.D. research topic on sea snakes that shaped my entire professional career. He freely gave his time and expertise to help many young visiting scientists prosper in their special fields of study. One of the "official" activities of visiting researchers and students was to visit Hy's office and kibitz about their research. For this we are all very grateful.

Hy was not a man who tried to impress others by putting on airs. Instead, he was equally friendly to the Museum's housekeeping staff and the top administrators of the Field Museum and other lofty institutions. He was not impressed with administrative rank and academic credentials, and he applied uniquely Marxian methods to make this evident. In his assignment of nicknames, no one received much respect and no one could hide! For example, Robert K. Johnson, Chairman of the Zoology Department, was "Bunky" or "El Bunko Grande," James P. Bacon, Curator of Reptiles, San Diego Zoo, was "Bakey," and George Rabb, Director of the Brookfield Zoo, was "Georgy Porgy." Of course, behind each of these nicknames was an endearing story that showed how Hy paid attention to the human beings with whom he lived and worked. We were individuals, not Directors, Curators, and Chairmen. In the end, that is why so many at the Field Museum and in the field of herpetology counted Hy Marx as a close friend, a great colleague, and a real human being. Hy Marx was truly one of a kind, absolutely unique, an amazing rare bird, and irreplaceable. All of our lives have been immensely enriched by knowing Hy Marx, and we will miss him greatly.

Literature Cited

Bauer, M.J. 1954. Frogs, frogs, frogs — and more frogs. *Chicago Natural History Museum Bulletin* 25(5):5.

Inger, R.F. and H. Marx. 1965. The systematics and evolution of the Oriental colubrid snakes of the genus Calamaria. *Fieldiana Zoology* 49:1–304.

Marx, H. and G.B. Rabb. 1972. Phyletic analysis of fifty characters of advanced snakes. *Fieldiana Zoology* 63:1–321.

Marx, H., G.B. Rabb, and H.K. Voris. 1977. The differentiation of character state relationships by binary coding and the monothetic subset method. *Fieldiana Zoology* 72:1–20.

Resetar, A. and H.K. Voris. 1997. Herpetology at the Field Museum of Natural History: The first one hundred years, pp. 495–506. In: T.W. Pietsch and W.D. Anderson, Jr. (eds.), *Collection Building in Ichthyology and Herpetology*. American Society of Ichthyologists and Herpetologists, Lawrence, Kansas.

Stewart, M.M. and C. Redhed. 2002. Hymen Marx. *Copeia* 2002:524–526.

Harold K. Voris and Alan Resetar
Division of Amphibians and Reptiles
Department of Zoology
Field Museum of Natural History
1400 South Lake Shore Drive
Chicago, Illinois 60605

IRCF ON THE MOVE

Michigan Members Represent IRCF at Chicago's Reptile Fest

The IRCF was represented at the Chicago Herpetological Society's largest public event of the year, Reptile Fest, by several Michigan members. Fest is an educational family event that draws thousands of spectators over the course of the weekend. CHS has helped to raise awareness of endangered reptiles and been supportive of IRCF-sponsored conservation projects for many years.

STEPHANIE BEISER

Michigan IRCF members (from left) include Chris Niezgucki, Jane Billette, Dr. Jen Periat, Karen Niezgucki, and Stephanie Beiser.

STEPHANIE BEISER

A young attendee takes a moment to read the IRCF informational posters.

STEPHANIE BEISER

Jane Billette and her eight-year-old Blue Iguana hybrid, Azul.

IRCF materials were incorporated into the "Iguana Squad" display, which is always a star attraction. Several species of *Cyclura* and *Ctenosaura* were on hand to represent the various endangered members of their genera. Many people were unaware of the critical status of some of these species, and were especially moved by a photo of the Blue Iguana Slugger and the story of his death by feral dogs.

CaribSea Donates Over $7,000 Toward IRCF-Supported Programs

CaribSea, a leading manufacturer of tropical aquarium products, has integrated conservation into the marketing strategy for its new reptile division, Blue Iguana Products. The new products feature the name and image of the Grand Cayman Blue Iguana, helping raise awareness of the plight of one of the IRCF's core initiatives, the Blue Iguana Recovery Program. Additionally, CaribSea has created marketing campaigns to raise money for other IRCF-supported programs, including Project Heloderma and Project Palearis. The "Buy your own Discount" Program, for example, encourages CaribSea customers to donate money to the IRCF. The customer receives substantial discounts on CaribSea products, and CaribSea matches funds donated by its customers. To date, over $7,000 has been raised.

CaribSea also is undertaking the innovative "Survivor Program" to raise awareness and funds for the American Cancer Society and the Blue Iguana Recovery Program. Featuring Sabrina K. Carpenter, an office manager at CaribSea and a cancer survivor, the program features a poster of Sabrina and her artfully crafted Blue Iguana tattoo. The poster is available to individuals who donate $25 or more to either the American Cancer Society or the IRCF in care of the Blue Iguana Program. "I am a cancer survivor and, much like the Grand Cayman Blue Iguana, we are both endangered species. Survival is a team effort. People's donations and volunteerism can make a difference," says Sabrina on her motivation for both the tattoo and the program.

For more information about these programs, CaribSea and its Blue Iguana line of products, or simply to see a great example of how conservation can be successfully incorporated into a "go-to-market" strategy, visit CaribSea's website at www.carib-sea.com.

Meeting of Project Heloderma and Project Palearis Partners

A meeting was held on 4 April 2007 in Las Vegas, Nevada for the partners engaged in projects Heloderma and Palearis for the preservation of the Guatemalan Beaded Lizard and the Guatemalan Black Iguana, respectively. In attendance were John Binns (IRCF), Luis Alvarado (Zootropic), and Brad Lock (Zoo Atlanta). Discussions addressed the acquisition of land in

DANIEL ARIANO

This female Guatemalan Black Iguana (*Ctenosaura palearis*) was the first female to be located and remains under observation by Project Palearis staff.

Guatemala for the proposed reserve and breeding facility; funds are in hand and final arrangements are being made. Initial ideas for the construction of the breeding facility were put forward as were plans for the upcoming field season. Project Palearis received a boost with a new donation of $1,000 from the IRCF. Further funding is being sought for Project Heloderma.

Update from Guatemala

Daniel Ariano of Zootropic has sent photos and observations from his recent

DANIEL ARIANO

The research site in the Motagua Valley, normally green during January and February, is parched and brown, with temperatures reaching 45 °C.

trip to the Motagua Valley of Guatemala. Beaded Lizards continue their hibernation in the same shelters. They will be taken from their shelters soon for health checks and to have transmitters replaced. Individual *Ctenosaura palearis* under observations also are due for health checks. This year is one of the hottest years ever in the Motagua Valley, with recorded temperatures as high as 45 °C (113 °F) during January and February (usually a cold period). The predictions are that this is going to be a dry year with a high probability of no rainfall at all.

Sand Dune Lizard

The IRCF is sponsoring conservation work in Argentina for the endangered Sand Dune Lizard, *Liolaemus multimaculatus* (see article on p. 66). Principal investigator, Federico Kacoliris, who is conducting his doctoral research on these lizards, reports that Sand Dune Lizards are beginning to wind down their activity during the months of April and May in anticipation of their winter brumation during June through August.

Based on field data collected to date on the Sand Dune Lizards and the vegetation in their natural habitat, the gov-

FEDERICO KACOLIRIS

An adult Sand Dune Lizard, *Liolaemus multimaculatus.*

ernment of Buenos Aires Province is enacting legislation to create a new Coastal Dunes Reserve, a critical first step toward conservation of the species. Data also have been used to develop an educational campaign aimed at the residents of several coastal cities within the species' distribution.

Equipment donated by the IRCF is crucial for carrying out studies slated for the upcoming year. The goal of the program is to produce a long-term conservation and management plan for *Liolaemus multimaculatus* and its habitat.

Volunteers Sought for Team Blue 2007

The IRCF staff has been busy constructing a robust online volunteer section to facilitate signup for this year's Team Blue activities in support of the Blue Iguana Recovery Program. Opportunities are available for people with all levels of physical ability, from providing care for the Blues at the captive breeding facility in the Queen Elizabeth II Botanic Park, to performing fieldwork in the Salina Reserve, and participating in a population census for Sister Isles Iguanas on Little Cayman Island. Check out www.ircf.org/volunteer.html and sign up for the experience of a lifetime.

Volunteers can sign up at the IRCF web site for volunteer opportunities on Grand Cayman or Little Cayman, Cayman Islands.

Connecticut Iguana Sanctuary in Need of Support

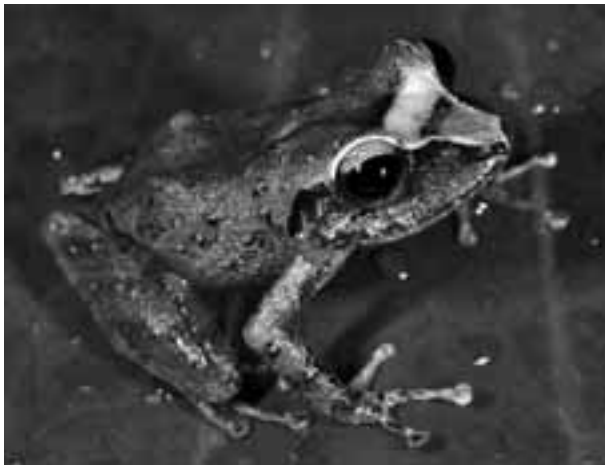
For the past ten years, the Connecticut Iguana Sanctuary has been rehabilitating and placing reptiles and providing shelter for many others that are elderly or disabled. In order to continue providing such services to the public, the Sanctuary is very much in need of financial support. For further information and opportunities to sponsor rehabilitated animals and long-term residents, please see www.reptilecare.com/ctiguana.htm or contact AJ Gutman at AJ@IRCF.org.

IRCF
International Reptile Conservation Foundation

Editors' Remarks

Although our focus remains on reptiles and their conservation, we will include from time-to-time references to amphibians (as indicated in this space in the previous issue). The plight of the Earth's amphibians is eloquently summarized in the "Commentary" by Jeffrey P. Bonner (p. 122). Faced with a host of perils that range from fungal diseases to habitat destruction and global climate changes, amphibians may well serve as indicators of human-mediated changes that threaten entire ecosystems. We would be wise to closely monitor the situation for the sakes of frogs and salamanders, all wildlife, and even our own futures.

The Editors of IGUANA



ROBERT POWELL

The St. Vincent Frog (*Eleutherodactylus shrevei*) is listed on the IUCN Red List as "endangered," primarily due to a very restricted range on a single island, where it appears to depend on increasingly threatened rainforest habitats. However, the discovery of the chytrid fungus in the West Indies, its almost inevitable introduction onto St. Vincent, and the fact that amphibians that occupy habitats at high elevations appear to be most vulnerable to its effects speak clearly and sadly to an uncertain future for this tiny frog.

Statement of Purpose

The International Reptile Conservation Foundation works to conserve reptiles 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

IGUANA, the Journal of The International Reptile Conservation Foundation, is distributed quarterly.

Annual Rates:

Individual U.S. or Canadian Membership	$25.00
Individual Membership, Digital (Adobe PDF)*	$25.00
International Membership	$50.00
U.S. Institutional Subscription,	$30.00
International Institutional Subscription	$55.00

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.

www.IRCF.org

Join Online at: www.IRCF.org

Membership Questions?

Email: info@IRCF.org, or contact AJ at 860-236-8203, 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 IGUANA. General articles can deal with any aspect of reptilian biology, including conservation, behavior, ecology, physiology, systematics, or husbandry. Submission of photographs to accompany articles is encouraged. Manuscripts may be submitted via e-mail (send to AJ@IRCF.org). Authors of one page or more of print will receive a free copy of the journal in which their contribution appears, and will receive a PDF file of their article for distribution.

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.

 Iguana, Conservation, Natural History, and Husbandry of Reptiles (ISSN 1098-6324) is published quarterly by the International Reptile Conservation Foundation, a nonprofit, tax-exempt organization, 3010 Magnum Drive, San Jose, CA. Periodical postage paid at San Jose, CA.

The Ornate Box Turtle (*Terrapene ornata ornata*) in Colorado

ERIC GANGLOFF

The Western or Ornate Box Turtle (*Terrapene ornata ornata*) is a widely distributed and familiar animal on the central plains of the United States, and is considered common throughout much of its range. The Ornate Box Turtle's approachability and charisma have made it a favorite of adults and children alike for many generations. Unfortunately, its gentle demeanor has made it a target for the pet trade, its slow movements have made it an easy roadkill, and human activities have destroyed and fragmented its habitat.

Despite its perceived abundance, few extensive studies have been done on populations of *T. o. ornata*, and none have been conducted in Colorado. Scientific research on other populations and local anecdotal evidence point to rapidly declining populations. The Colorado Reptile Humane Society is launching the Colorado Box Turtle Project, a study of populations of *T. o. ornata* to better understand population dynamics, land use, and impacts of human activities, which include harvesting for the pet trade. As Colorado's eastern plains continue to be heavily developed, this information will aid in determining population viability and conservation needs for this species before it becomes too late to prevent extirpation.

The Colorado Reptile Humane Society is currently seeking funding sources and equipment donations to support the Colorado Box Turtle Project. For more information, including a more detailed project description, please visit:

www.corhs.org/boxturtleproject.html
or contact
boxturtleproject@corhs.org.

THOMAS WIEWANDT, WILD HORIZONS

Colorado populations of the Ornate Box Turtle (*Terrapene ornata*) appear to be declining rapidly. See the "Focus on Conservation" (facing page) for more information.

Argentine Sand Dune Lizard (*Liolaemus multimaculatus*). See article on p. 66.

FEDERICO KACOLIRIS