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REPTILES & AMPHIBIANS

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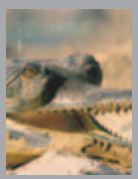
LESTER MELENDEZ

The prehensile tail of this Arboreal Alligator Lizard (*Abronia vasconcelosii*) is an adaptation for climbing. Lizards in the genus *Abronia* are among the most endangered species of lizards in the world. The ten species known from Guatemala (eight of them endemic) represent but one group for which the IRCF supports research and conservation efforts. See the article on p. 216.

ROBERT POWELL

Non-native flora and fauna have forever changed the ecosystems in southern Florida. Exotic reptiles have been particularly successful in establishing populations, with many of them dominating habitats altered in various ways by human activities. This juvenile Black Spinytail Iguana (*Ctenosaura similis*) from Key Biscayne effectively exploits a hollow rail of a chain link fence as a refugium conveniently close to an ideal basking site. See conservation research reports on pp. 249 and 251 and the report of a new introduced amphibian in Florida on p. 248.



Front Cover: Olivier Born

Gharials (*Gavialis gangeticus*) are found today in only a few protected areas separated by hundreds of kilometers. The Gharial Conservation Alliance protects critical riverine habitats and engages in educational efforts. See the article on p. 216.

Back Cover: William W. Lamar

Annulated Treeboas (*Corallus annulatus*) occur mostly in lowland tropical rainforests from eastern Guatemala south through much of Central America and into northern Colombia west of the Andes. See the article on p. 202.

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MEL JOSE RIVERA RODRIGUEZ

Treeboas in the genus *Corallus* occur in Central and South America and in the Lesser Antilles. As implied by the common name, these slender snakes are highly arboreal and rarely descend to the ground. Smaller treeboas, such as this subadult *C. grenadensis* from Union Island on the Grenada Bank, feed almost exclusively on anoles, whereas larger individuals shift to a diet of small mammals. See the article on p. 202 on the natural history of *C. annulatus*, about which little is known.

Exotic Cuban Treefrogs (*Osteopilus septentrionalis*) are less cold-tolerant than native treefrogs and cannot survive sustained cold winters.

Ontogenetic Behavioral Shifts in Habitat Utilization of Treefrogs (Hylidae) in North-central Florida

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Photographs by Kenneth L. Krysko.

Natural history data through all stages of an animal's life cycle are necessary for making sound management decisions, which are especially critical in Florida, where developmental pressure often comes at the cost of species and their habitats. Despite being locally abundant, relatively little was known about ontogenetic behavioral shifts in habitat utilization for many hylid treefrogs. In this study, we used polyvinyl chloride (PVC) pipes to survey treefrogs in the localized, but habitat- and species-diverse University of Florida Natural Areas Teaching Lab (NATL) in north-central Florida. A variety of habitat variables were tested over multiple trapping seasons. We found that treefrog species were primarily limited by the presence of some water source or moisture, although some species were more tolerant of drier conditions than others. Ontogenetic shifts in habitat exploitation were detected only in limited instances, with juvenile Green Treefrogs (*Hyla cinerea*) demonstrating a narrower niche than adults, and juvenile Squirrel Treefrogs (*Hyla squirella*) being most commonly captured during winter and spring. The non-native Cuban Treefrog (*Osteopilus septentrionalis*) ranked third in species detection, and its distribution was highly limited by both season and habitat type. With much to be learned about amphibian biology and natural history, efforts should be made to continue local studies such as this to enable conscious management and conservation decisions.

Life history characteristics of species are important aspects to consider for both applied conservation and management practices. While many studies have addressed survivorship and reproductive potential, few have examined ontogeny. Ontogenetic shifts are not restricted to morphology, but apply to the entire life cycle of an organism. Appropriate studies of ontogenetic behavioral shifts are lacking in the literature, and these types of data for amphibians and reptiles are nearly absent. Treefrogs in the family Hylidae provide an excellent model to address such questions, because multiple species tend to be sympatric and syntopic, are abundant and congregate in large densities, and size classes are documented (Wright and Wright 1949).

Little information is currently known about life history characteristics of hylid treefrogs away from breeding ponds (Garton and Brandon 1975, Ritke and Babb 1991). Large numbers of treefrogs are not typically represented in herpetological surveys that employ drift-fence arrays, as tree-

Pine Woods Treefrogs (*Hyla femoralis*) occur in wetlands and upland pine at the NATL.

Green Treefrogs (*Hyla cinerea*) are the second most abundant species of treefrog at the NATL, where they frequently are found in all habitat types.

Squirrel Treefrogs (*Hyla squirella*) in a PVC-pipe refugium at the NATL.

Non-native Cuban Treefrogs (*Osteopilus septentrionalis*) are capable of consuming an array of both exotic and native invertebrates and vertebrates.

frogs easily escape by climbing out of pitfall and funnel traps (Gibbons and Bennett 1974, McComb and Noble 1981, Lohoefener and Wolfe 1984, Dodd 1991, Murphy 1993, Greenberg et al. 1994). Visual detection methodologies also are difficult, as treefrogs are generally small and often prefer densely covered habitats (Duellman and Trueb 1985). However, the use of polyvinyl chloride (PVC) pipes provides a simple and effective means to passively attract and thus sample treefrogs (Greenberg et al. 1994, Domingue O'Neill and Boughton 1996, Moulton et al. 1996, Boughton et al. 2000, Zacharow et al. 2002).

Currently, 14 native and one established non-native hylid species occur in Florida. All use generally similar habitats and are primarily restricted in distribution by the presence of a fresh water source, although some species are more tolerant of drier conditions and at least occasional exposure to brackish water (Wright and Wright 1949, Neill 1951). The use of PVC pipes can be effective for sampling multiple taxa, although in previous studies that have used them, not all species and size classes were represented equally (Domingue O'Neill and Boughton 1996, Moulton et al. 1996, Boughton et al. 2000).

Previous studies conducted in north-central Florida captured five arboreal hylids (Domingue O'Neill and Boughton 1996, Boughton et al. 2000). These included the Green Treefrog (*Hyla cinerea*), Pinewoods Treefrog (*Hyla femoralis*), Squirrel Treefrog (*H. squirella*), Spring Peeper (*Pseudacris crucifer*), and Cuban Treefrog (*Osteopilus septentrionalis*). The Spring Peeper has an expansive geographic distribution, ranging from southeastern Manitoba to eastern Texas. The Cuban Treefrog was first reported in Florida in the 1930s (Barbour 1931) and is now widespread throughout the peninsula (Meshaka et al. 2004). This treefrog thrives in habitats affected by anthropogenic disturbances, and has been found as far north as Canada (McGarrity and Johnson 2009). It is known to prey on many native invertebrates and vertebrates, such as lizards, frogs, snakes, and members of its own species (Meshaka 1996a, 2001; Krysko and Halvorsen 2010; Granatosky et al. 2011). While the diet of the Cuban Treefrog is relatively well documented compared to other non-native herpetofauna in Florida, additional information pertaining to the negative effects on the native faunal assemblage and how this species utilizes space could prove useful for management and control plans. The Green Treefrog, Pinewoods Treefrog, and Squirrel Treefrog have similar geographic ranges along the Atlantic and Gulf coastal regions of the southeastern United States (Wright and Wright 1949). These treefrog species share a similar distribution throughout Florida, and are more or less limited by the presence of fresh water and high humidity levels (Duellman and Trueb 1985). While proximity to fresh water plays an integral role in habitat utilization and selection, relatively little is known about taxon-specific or size-based habitat exploitation (Boughton et al. 2000).

Few studies have addressed the possibilities of ontogenetic habitat shifts in arboreal anurans. Dispersal has been defined as movement of an individual from one habitat to another, or away from the parental group (Jameson 1956, Semlitsch 2008). Dispersal not only affects the individual, but also influences inclusive fitness, genetic viability, and population dynamics. Many hypotheses seek to explain dispersal, and some assume that it is a mechanism to reduce potential inbreeding depression (Dunning et al. 1995, Hanski and Gilpin 1997, Hanski 1999) or incidence of parent/offspring competition (Dunning et al. 1995, Hanski and Gilpin 1997, Hanski 1999). While few studies have addressed the possibility of ontogenetic dispersal in treefrogs, some form of age-specific habitat distribution is likely (Jameson 1956).

Studies conducted over multiple trapping months have reported seasonal activity shifts in treefrog diversity and abundance, with both greatest in summer and late fall before decreasing during winter and early spring (Boughton et al. 2000; Johnson et al. 2007, 2008; Ackleh et al. 2010). This seasonal activity pattern is most commonly associated with cold winters, and populations of the exotic Cuban Treefrog tend to be more susceptible to colder conditions than their native counterparts (Meshaka 1996b). In this paper, we attempt to determine whether characteristics such as ontogeny, habitat type, pipe diameter, and pipe placement influence the sampling of hylid species at the Natural Areas Teaching Lab (NATL), University of Florida (UF), Gainesville, Alachua County, Florida. Additionally, we examined the diet of the Cuban Treefrog to determine the incidence of predation on native fauna.

Florida Water Snakes (*Nerodia fasciata pictiventris*) are frequently encountered in the wetlands of the NATL, where they feed largely on fishes and amphibians, facultatively consuming treefrogs of all life stages.

Gopher Tortoises (*Gopherus polyphemus*) occur in the upland pines and old-field succession of the NATL. They represent a keystone species, as their burrows are known to house more than 200 species of animals.

Materials and Methods

Study area.—This study was conducted at the NATL, located at 29.63434°N, -82.36755°W (WGS84 datum, 26 m elev.). The NATL is managed by the University of Florida and consists of 19.83 ha of four primary habitat types (hammock, upland-pine, wetland, and old-field succession). Due to the highly localized and diverse array of ecotypes, the NATL provides an ideal study area to address multiple questions related to ontogenetic habitat use in hylid treefrogs. Hammock habitat was defined as shaded, with thick stand of hardwoods and sparse pines; wetland habitat included some form of permanent water retention; upland-pine habitat was identified by well-drained soils and widely spaced longleaf pines with sparse understory vegetation; and old-field successional habitat was characterized by the presence of

Hammock habitat is characterized by thick stands of shade-tolerant hardwoods, few pines, and sparse understory vegetation. The area has well-drained soils that are relatively high in nutrients due to decaying organic leaf litter. Hammock ecosystems are common in north-central Florida.

Upland-pine habitat, often referred to as a sandhill ecosystem, occurs in upland areas with well-drained soils. A healthy upland habitat is dominated by widely spaced Longleaf Pines (*Pinus palustris*) with few understory shrubs and a dense ground cover of grasses and herbs.

Old-field habitat is a result of recently cleared land prepared for farming and then abandoned. Once abandoned, the area will slowly return to a wild state, but first must phase through transitional states with more or less predictable successional floral assemblages. A typical old-field succession in north-central Florida is dominated successively by annual weeds, blackberry and dog fennel, Loblolly Pine (*Pinus taeda*), and mixed hardwoods.

Wetlands are areas of lower elevation that include some form of permanent water retention. These areas also are characterized by the presence of ephemeral ponds that fill during rainy months. These ponds have no fish, facilitating amphibian reproduction and growth.

annual weeds and sparse hardwoods. Standard maintenance at the old-field site continually clears ground vegetation, and large dense hardwoods and pines are removed before they become established.

Sampling.—Ninety-six PVC pipes measuring 760 mm in length were divided into three size groups based on the internal diameter of the pipe (12.7, 19.1, and 25.4 mm). Pipes were evenly distributed across 16 randomly selected sites among the four primary habitat types. These pipes were further subdivided into two subgroups based on elevation; one group was placed in the ground and the other approximately 1.82 m above the ground.

Sampling efforts were divided into two trapping periods, opened continuously from 1 August–30 October 2010 and 6 January–15 March 2011, which allowed for examining potential effects of seasonal variation in treefrog abundance. One trap-day equaled one trap open for a 24-hour period. A 30-day acclimation period allowed treefrogs to locate and habitually utilize pipe refugia. Traps were checked *ad libitum* throughout the trapping session.

Upon capture, treefrogs were identified to species, and measured (± 0.03 mm) for snout-vent length (SVL) using Tresna Instrument IP 67 Waterproof Digital Calipers (www.Tresnainstrument.com). Native species were subsequently released unmarked at the capture site; however, all Cuban Treefrogs were removed as it is illegal to release non-native species without a permit from the Florida Fish and Wildlife Conservation Commission (Florida Statute § 379.231). Treefrogs observed perched on or next to pipe refugia were captured by hand and added to species totals. Captures were divided into size classes (i.e., juveniles or adults) based on previously published morphometric criteria for each species. Adults reported for each species include 37-mm SVL for the Green Treefrog, 25-mm SVL for the Pinewoods Treefrog, 23-mm SVL for the Squirrel Treefrog, 19-mm SVL for the Spring Peeper, and 28-mm SVL for the Cuban Treefrog (Wright and Wright 1949; Meshaka 2001). Removed Cuban Treefrogs were examined for stomach contents; invertebrates were identified to order and vertebrates to species. Representative Cuban Treefrogs were deposited as vouchers in the Florida Museum of Natural History.

Relative species composition and total captures were recorded. Pearson's chi-square tests were used to determine whether treefrog distribution was influenced by any habitat variables (habitat type, pipe elevation, pipe diameter, and seasonal activity), or by ontogenetic behavioral shifts between juveniles and adults of both Green Treefrogs and Squirrel Treefrogs. Statistical analyses were performed on quantpsy.org, an interactive calculation tool for chi-square tests of goodness of fit and independence (Preacher 2001) with $\alpha = 0.05$.

Results

In 15,360 trap-days, 549 total captures were made of five treefrog species: The Squirrel Treefrog, Green Treefrog, Cuban Treefrog, Pinewoods Treefrog, and Spring Peeper (Table 1). The latter two species were excluded from statistical analyses because of small sample sizes. High numbers of juvenile and adult Squirrel Treefrogs and Green Treefrogs allowed for analysis of ontogenetic shifts in habitat exploitation for these two species.

Hundreds of male Green Treefrogs (*Hyla cinerea*) congregate in wetlands, where the breeding choruses can be deafening.

Table 1. Species and age classes observed in the Natural Areas Teaching Lab (Gainesville, Florida), 08/2010–03/2011.

Species	Juveniles	Adults	Total
Hyla squirella	74	233	307
Hyla cinerea	76	113	189
Osteopilus septentrionalis	9	35	44
Hyla femoralis	0	8	8
Pseudacris crucifer	0	1	1
Total			549

Interspecific variation of species presence between the four habitat types suggested that captures were not randomly distributed ($\chi^2 = 43.920$, df = 6, $P < 0.001$). The Squirrel Treefrog was the most cosmopolitan treefrog and was found in high densities in all habitat types, whereas the Green Treefrog was more restricted in its distribution. The Pinewoods Treefrog was captured in low densities throughout the site, and only one Spring Peeper was captured in the wetland habitat. The Cuban Treefrog was limited to certain habitats (Table 2). Both juvenile and adult Green Treefrogs ($\chi^2 = 4.563$, df = 3, $P = 0.206$) and Squirrel Treefrogs ($\chi^2 = 5.663$, df = 3, $P = 0.129$) were found randomly among the four habitat types.

Table 2. Total treefrogs observed throughout the study period in each of the representative habitats.

Species	Hammock	Wetland	Upland-pine	Old field
Hyla squirella	96	74	50	87
Hyla cinerea	59	73	22	35
Osteopilus septentrionalis	2	9	15	18
Hyla femoralis	3	4	0	1
Pseudacris crucifer	0	1	0	0

The Green Treefrog, Squirrel Treefrog, and the Cuban Treefrog utilized PVC pipe sizes differently from one another ($\chi^2 = 20.759$, df = 4, $P < 0.001$). The Squirrel Treefrog was captured disproportionately more often (41.04%) in 12.7-mm diameter pipes than the other species, whereas the Green Treefrog was found most frequently (43.92%) in 25.4-mm diameter pipes. No particular pattern was observed for Cuban Treefrogs, as they appeared to show no preference for any of the three PVC pipe diameter sizes (12.7 mm = 38.64%, 19.1 mm = 36.64%, and 25.4 mm = 24.72%). Subsamples based on size-class revealed that juveniles and adults for both the Green Treefrog ($\chi^2 = 5.540$, df = 2, $P = 0.063$) and Squirrel Treefrog ($\chi^2 = 2.333$, df = 2, $P = 0.311$) did not utilize different PVC pipe diameters.

The Green Treefrog, Squirrel Treefrog, and Cuban Treefrog were captured more frequently (81.42%) in PVC pipes placed in the ground rather than on trees (18.58%), but did not utilize PVC pipes differently from each other ($\chi^2 = 0.026$, df = 2, $P = 0.987$). We found no difference in pipe-height use between juvenile and adult Squirrel Treefrogs ($\chi^2 = 0.187$, df = 1, $P = 0.665$). We did detect a significant difference in pipe-height use between adults and juveniles of Green Treefrogs ($\chi^2 = 5.986$, df = 1, $P = 0.014$); juveniles were largely restricted to pipes placed in the ground (89.47%), whereas adults were less habitat-specific (ground = 75.22%, and tree 24.78%).

Treefrog abundance varied significantly between the two trapping periods ($\chi^2 = 23.799$, df = 2, $P < 0.001$). Both Green Treefrogs and Squirrel Treefrogs were observed in relatively similar densities between the two trapping periods (Table 3). The Cuban Treefrog was more common in the first (84.09%) than in the second (15.91%) trapping period. Ontogenetic variation in seasonal treefrog abundance revealed differences in juvenile Squirrel Treefrog representation ($\chi^2 = 10.204$, df = 1, $P = 0.002$). Juvenile captures were more common (67.11%) in the spring trapping period. No ontogenetic shift was observed in the Green Treefrog sample ($\chi^2 = 0.098$, df = 1, $P = 0.754$). Graphic representation of the number and type of each treefrog captured also indicated seasonal trends in certain groups (Fig. 1). Cuban Treefrogs, juvenile Squirrel Treefrogs, and Pinewoods Treefrogs were captured more frequently in one trapping period than the other. All observations of Pinewoods Treefrogs were in the second trapping period, but due to small sample sizes, we could not dismiss the possibility of random captures.

Table 3. Treefrog captures observed between the two trapping sessions. The first trapping session (1 August–30 October 2010) was selected to represent environmental conditions of late summer and fall, while the second trapping session (6 January–15 March 2011) was selected to represent late winter through early spring. Seasonal variation in treefrog abundance was generally similar for *H. squirella* and *H. cinerea*. The seasonal abundance in *O. septentrionalis* varied significantly between the two trapping seasons. *Hyla femoralis* and *P. crucifer* were excluded from all analyses due to the low number of captures throughout the study period.

Species	Spring	Fall
Hyla squirella	145	162
Hyla cinerea	112	77
Osteopilus septentrionalis	37	7
Hyla femoralis	0	8
Pseudacris crucifer	1	0

We removed 44 Cuban Treefrogs ranging from 24.20–51.30 mm SVL. Eleven specimens (25.00%) contained at least one animal in their digestive tracts. Invertebrates made up a substantial portion (90.91%) of the contents identified and consisted of three orthopterans, two hymenopterans, two blattarians, and one each in the orders Areneae, Scorpiones, Hemiptera, and Lepidoptera. One anuran, a juvenile (21.30 mm SVL) Green Treefrog, was found in an adult Cuban Treefrog (49.50 mm SVL; UF 160926).

Discussion

This study demonstrates the effectiveness of PVC pipes as a means of capturing and sampling certain hylid treefrogs. We captured all of the five treefrog species known to occur at the NATL, although some capture biases were evident. Similar to previous studies (Boughton et al. 2000, Domingue O'Neill and Boughton 1996), Pinewoods Treefrogs and Spring Peepers were either more difficult to capture and/or less abundant than other species. Consequently, a different survey method should be used to effectively study these species. Despite certain capture biases, PVC pipes effectively captured Green Treefrogs, Squirrel Treefrogs, and Cuban Treefrogs. Whether this was a result of actual selection of PVC pipe refugia or relative abundance within each habitat type was not clear. The relatively low capture rates of Cuban Treefrogs might have been a result of low numbers at the beginning of the study (personal observation) and not an actual representation of selection for or against PVC pipe refugia; however, this species was found to be refuge-limited in southern Florida (Meshaka 2001).

Certain species captured throughout the study tended to be highly habitat specific. Due to similar ranges, both inter- and intraspecific competition was an expected consequence of resource limitations in a localized system. Despite being captured in large numbers in all habitat types, Squirrel Treefrogs were most commonly observed in old-field and hammock habitats.

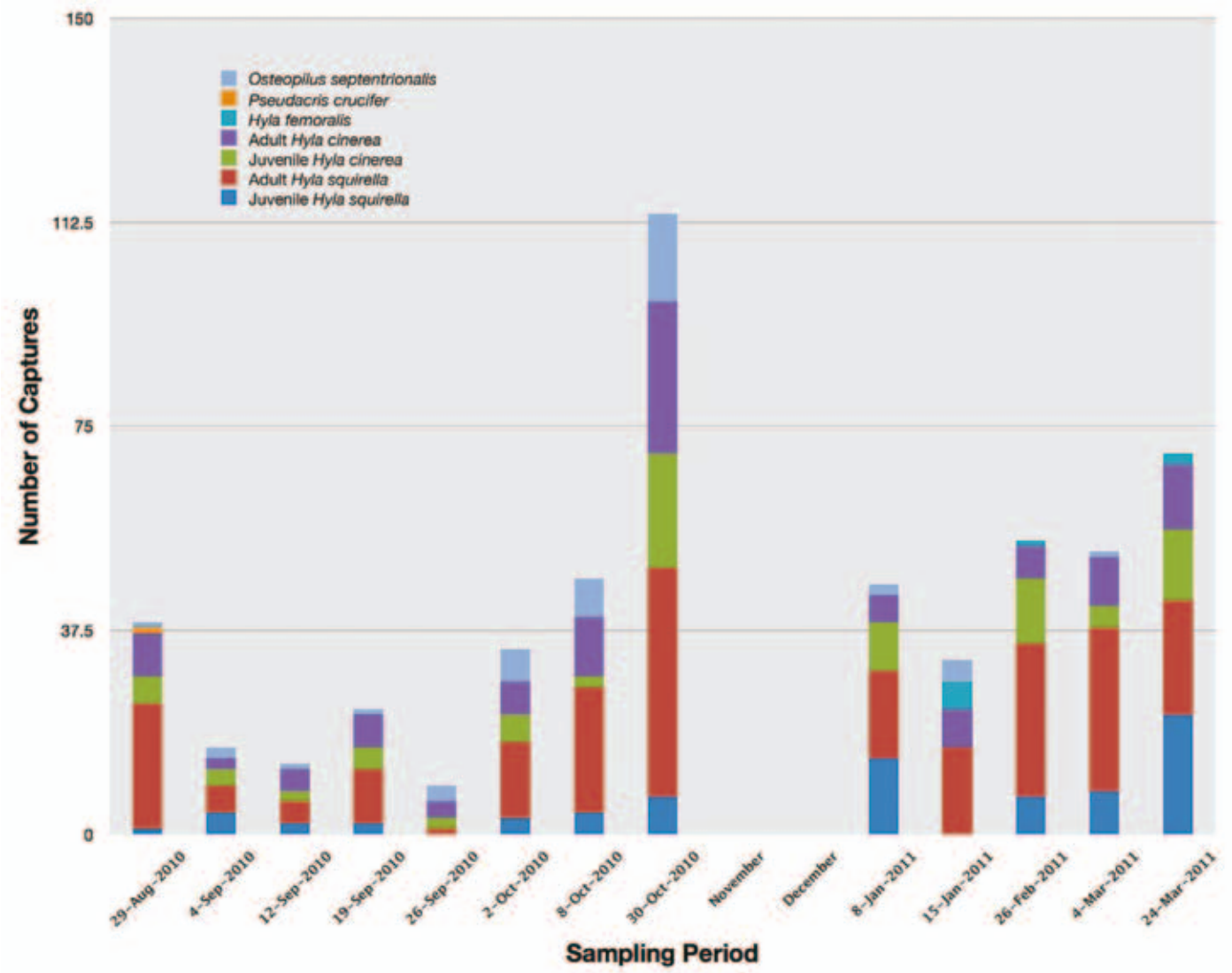

Fig. 1. Treefrog total and species representation observed throughout study. Differences in species captured appear to indicate that seasonality may be a driving force behind the presence or absence of particular types of treefrogs. Both exotic *Ostepilus septentrionalis* and juvenile *Hyla squirella* abundance tended to differ seasonally. Additional information also indicates that the presence of *H. femoralis* is seasonally driven, but due to low capture rates, we could not exclude the possibility of random observations.

The wide distribution of this species indicates that they are not limited by environmental conditions (i.e., moisture and vegetative composition), and distribution probably is limited only by the ability to find shelter or prey. Green Treefrogs were most abundant in hammock and wetland habitats, likely a result of moisture retention and heat. Although not tested, the thick canopy cover of the hammock habitat might have maintained sufficient levels of humidity (Goin 1958). The permanent source of water found in wetland habitat would have provided protection from desiccation. Non-native Cuban Treefrogs thrived in relatively disturbed environments (Meshaka 1996a), and the low disturbance factor of hammock habitat in the NATL might account for the low number of captures in that environment. The highest incidence of Cuban Treefrog captures was in old-field habitat, which is routinely managed in order to demonstrate early successional growth. Considering the rate at which natural ecosystems are becoming fragmented and/or developed, this exotic species likely will continue to thrive and spread into previously unoccupied regions. The versatility and resilience of these frogs also will render eradication plans difficult. Consequently, developing control plans, which could limit spread into new areas, might be more realistic.

Although some species appeared to utilize habitat types differently, Green Treefrogs, Squirrel Treefrogs, and Cuban Treefrogs demonstrated a strong tendency to use pipes placed directly in the ground rather than in a tree, and this seems to be a result of the amount of moisture that escapes from elevated pipes (see also Boughton et al. 2000). Constructing traps with some sort of water collection device (i.e., use of an end cap) might change capture rates in elevated pipes. Treefrog distribution was influenced by the internal diameter of refugia. Squirrel Treefrogs preferred smaller diameter pipes, whereas Green Treefrogs were more likely to use larger PVC refugia, suggesting that these species prefer the security of tight refugia close to the sizes of their bodies (Lee 1969, Wright and Wright 1949). Ontogeny appears to have little effect on how treefrogs utilize space. Both juvenile and adult Green Treefrogs and Squirrel Treefrogs did not use habitat types or pipe diameters in any predictable fashion, suggesting that suitable habitat was not a limiting resource. Limitations to population growth might instead be the result of some other factor such as prey availability, predation, or access to suitable breeding areas. The only observed instance in which ontogeny played some predictable role was in pipe elevations within the Green Treefrog data set. Our analysis indicated that juveniles were found disproportionately more often in ground pipes than adult conspecifics. Although ground pipes were preferred by all species and age-classes, adult Green Treefrogs appeared to be less selective, and a considerable number were captured in trees, suggesting that adult Green Treefrogs are more adept at exploiting potentially adverse conditions.

Dietary analysis of the Cuban Treefrog revealed that the majority of animal remains were invertebrates. Most notably, two different individuals (both 49.5 mm SVL) consumed native animals; one ate a Florida Striped Scorpion (*Centruroides hentzi*; 34.5 mm total length) (Granatosky et al. 2010), and one ate a Green Treefrog (juvenile 21.3 mm SVL). Meshaka (1996a, 2001) suggested that this exotic treefrog consumes an array of both exotic and native herpetofauna.

Previous studies (Meshaka 1996b, 2001; Boughton et al. 2000; Johnson et al. 2007; Johnson et al. 2008; Ackleh et al. 2010) demonstrated that treefrog abundance and distribution were influenced by seasonal climatic variation. We observed juvenile Squirrel Treefrogs in greater numbers in the spring sampling season, suggesting that as juveniles grow, they either use a different microhabitat in fall-winter or they venture away from these habitats. Cuban Treefrogs were most influenced by seasonal variation. This species is less cold-tolerant and cannot survive through sustained cold winters (Meshaka 1996a, 1996b). Managers should take advantage of cold weather conditions to remove and possibly eradicate localized Cuban Treefrog populations.

Due to recent declines in global amphibian populations, conservation action has been deemed important and essential for maintaining current population sizes as well as native biodiversity. The use of PVC pipe refugia has been demonstrated to be an effective means of capturing certain hylid treefrogs (Greenberg et al. 1994, Domingue O'Neill and Boughton 1996, Moulton et al. 1996, Boughton et al. 2000, Zacharow et al. 2002). Treefrog species tend to be limited in range by access to some source of fresh water or a means of retaining moist skin. Similar to other studies (Boughton et al. 2000), we found a great deal of variability in seasonal activity and in how treefrogs utilized space. Squirrel Treefrogs are extremely versatile and commonly found in large numbers across a wide range of habitat types, whereas Green Treefrogs appear to be limited by access to moist or humid conditions. Adult Green Treefrogs are more versatile in habitat exploitation than juveniles. At our study site, exotic Cuban Treefrogs were linked to disturbed areas. Because its superb colonizing abilities lower the likelihood of eradication in Florida, we believe that efforts would be better spent removing and controlling local populations. With much to learn about amphibian ecology and responses by amphibians to perturbations in their environment, studies such as this provide the sorts of life history data necessary for making informed resource management decisions.

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MIKE D. DUNN

Corallus annulatus from the Caño Palma Biological Station consuming what is likely a Brazilian Long-nosed Bat (*Rhynchonycteris naso*).

Ecological Notes on the Annulated Treeboa (*Corallus annulatus*) from a Costa Rican Lowland Tropical Wet Forest

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The Annulated Treeboa (*Corallus annulatus*; Figs. 1–4) is one of nine currently recognized species in the boid genus *Corallus* (Henderson et al. 2009). Its disjunct range extends from eastern Guatemala into northern Honduras, southeastern Nicaragua, northeastern Costa Rica, and southwestern Panama to northern Colombia west of the Andes (Henderson et al. 2001, McCranie 2010). It is the only species of *Corallus* found on the Caribbean versant of Costa Rica, where it occurs at elevations to at least 650 m and perhaps as high as 1,000 m (Solórzano 2004). *Corallus annulatus* occurs mostly in primary and secondary lowland tropical wet and moist rainforest (Holdridge 1967) and it appears to be genuinely rare (Henderson et al. 2001). Besides *C. cropanii* and *C. blombergi* (the latter closely related to *C. annulatus*), it is the rarest member of the genus. Aside from information on habitat and activity, little is known regarding its natural history.

In November 2001, a herpetological investigation at Caño Palma Biological Station, Tortuguero, in northeastern Costa Rica (Figs. 5 & 6) discovered the presence of *C. annulatus* from a single preserved specimen held at the biological station. Further surveys in the area detected the species in *Manicaria* swamp forest (Lewis et al. 2010) that apparently held locally common populations of the snake (Fig. 7). Further inventory and abundance surveys over the next ten years resulted in some preliminary morphometric and ecological data on *C. annulatus*.

Study Site and Methods

Caño Palma Biological Station's climate has average daily temperatures of 26 °C (23–32 °C) and 70% RH (60–95%). The region is subject to the customary wet (September–February) and dry (March–September) seasons of the Neotropics, but is often affected by onshore weather and storms from the Caribbean Sea. The Caño Palma area has highly unpredictable annual rainfall that can exceed 6,500 mm (Lewis 2009). Over 100 cm of rain over the course of a few days, resulting in temporary flooding of the station and its grounds, is not unusual. Such abundant and serious rainfall in a known lowland catchment area creates a habitat that is very wet, botanically diverse, and unusually dominated by palms (*Manicaria saccifera*, locally known as "Palma real"), resulting in a lowland tropical wet forest on risen terrain (Myers 1990, Lewis 2009, Lewis et al. 2010).

ALEX FIGUEROA

Fig. 1. *Corallus annulatus* in a palm (*Raphia taedigera*) at the Caño Palma Biological Station.

PAUL B.C. GRANT

Fig. 2. *Corallus annulatus* from the Caño Palma Biological Station after consuming a bat.

JOSH FELTHAM

Fig. 3. *Corallus annulatus* from the Caño Palma Biological Station.

ALEX FIGUEROA

Fig. 4. *Corallus annulatus* in a palm (*Raphia taedigera*) at the Caño Palma Biological Station.

Fig. 5. Costa Rica's provincial and northeastern zone.

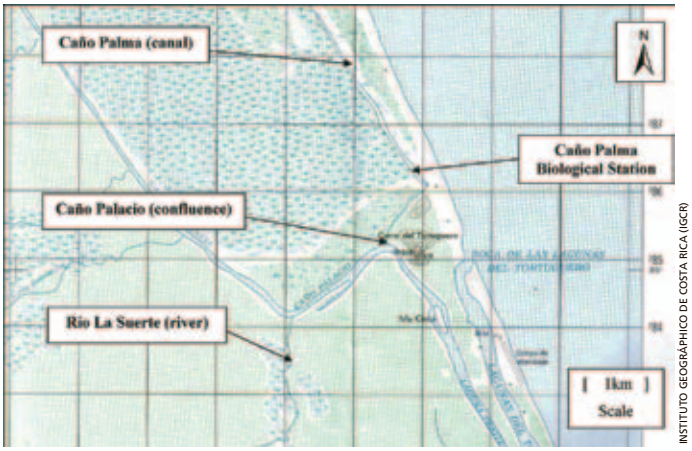

Fig. 6. Lithograph showing the approximate location of Caño Palma; the location of the Río La Suerte and the Caño Palacio/Caño Palma confluence.

Nocturnal visual encounter surveys (VES) (Heyer et al. 1994) were conducted on known trails and transects at Caño Palma Biological Station to locate *Corallus annulatus*. We were alerted to some additional individuals by local residents. Data recorded included morphometrics: Weight (g), snout-vent length (SVL), total length (TL); as well as sex, habitat, diet, and perch height (PH), where possible. Survey and morphometric measurements were carried out under research permits granted by the Ministerio del Ambiente Energía Telecomunicaciones (MINAET) under the Sistema Nacional de Áreas de Conservación (SINAC) investigation program. In the interest of conserving the species, and despite a lack of preserved specimens in known collections globally, no specimens were collected. Spearman Rank correlation coefficients (r_s) conducted in Statistica™ Ver. 7 (StatSoft, Inc., Tulsa Oklahoma) were used to investigate morphological characteristics.

Results and Discussion

Over a span of ten years, we captured ten female and ten male *C. annulatus* (Table 1), but observed 26 in total. Based on size data, 17 of the snakes

Table 1. Morphometric and habitat details of *Corallus annulatus* at Caño Palma Biological Station, 2001–2011 (SVL and total length in mm, mass in g, perch height in cm; NR = not recorded).

Date	Sex	Age	Color	SVL (TL)/Mass	Perch Height	Habitat	Prey
01 May 2001	F	Adult	orange	580 (654)/57	250	*Pentaclethra macroloba*	—
16 Aug 2001	M	Adult	gray	593 (800)/65	850	*Bambusa vulgaris*	—
21 Aug 2001	M	Adult	orange	992 (1,306)/172	300	*Manicaria saccifera*	—
12 Oct 2001	M	Adult	light gray	825 (1,210)/168	900	*Bambusa vulgaris*	—
28 Oct 2001	F	Adult	gray	600 (720)/56	380	*Citrus aurantiun*	—
12 Jan 2002	F	Juvenile	black	180 (270)/27	240	Boat dock	*Rhynchonycteris naso*
16 Nov 2002	M	Adult	gray/orange	672 (990)/96	850	*Bambusa vulgaris*	*Wilsonia canadensis*
29 Nov 2002	F	Adult	orange	590 (660)/44.5	550	*Bambusa vulgaris*	—
07 Jan 2003	M	Adult	orange	900 (1,100)/157	180	*Bambusa vulgaris*	—
15 Jul 2003	M	Adult	orange	512 (584)/36	200	*Manicaria saccifera*	*Rhynchonycteris naso*
28 Nov 2003	M	Juvenile	gray/orange	198 (287)/38	280	*Manicaria saccifera*	—
06 Dec 2004	M	Adult	orange	1,020 (1,200)/165	30	*Manicaria saccifera*	—
27 Jan 2005	M	Adult	orange	910 (1,250)/170	500	*Manicaria saccifera*	—
03 Feb 2005	F	Adult	orange	780 (970)/237	250	*Manicaria saccifera*	—
15 Feb 2010	F	Juvenile	gray	392 (472)/NR	NR	Pond shrub	—
17 Jul 2010	M	Adult	orange	874 (1,008)/NR	NR	Rancho building	Unidentified bat
15 Sep 2010	F	Adult	orange	1,434 (1,544)/448	120	*Zygia latifolia*	—
28 Dec 2010	F	Adult	gray/orange	968 (1,077)/282	120	*Vochysia ferrugenia*	—
10 Jun 2011	F	Adult	gray/orange	850 (1,013)/141	150	*Mangifera indica*	—
15 Jun 2011	F	Adult	orange	629 (738)/90	100	*Heliconia* sp.	—


TODD LEWIS

Fig. 7. Typical *Manicaria* palm swamp forest, dominated by Palma Real (*Manicaria saccifera*), at the northern section of the Caño Palma Biological Station's forest.

were adults and three were juveniles. Mean SVL of males was 749.6 ± 81.1 mm (198–1,020 mm) and for females 700.3 ± 107.8 (180–1,434 mm) (Fig. 8). We found a female of 1,434 mm SVL and 1,544 mm total length, very close in size to the largest known individual, also a female, of 1,447 mm SVL (1,725 mm total length) from Guatemala (Smith and Acevedo 1997). Mass varied between 27 and 448 g. Total length, SVL, and mass were all positively correlated (r_s = 0.789, 0.955, 0.913; P < 0.05).

Fifteen of the boas were orange to cinnamon in dorsal coloration, with brown/orange saddle markings. Four were a slate-gray to brown with dark crossbands and saddle markings. Only one individual was black, but we do not think it was melanistic or anerythristic due to the fact that it showed partial saddle markings and lighter markings on the underside. Color did not correlate significantly with morphology (r_s = -0.464; P > 0.05) and did not relate to gender.

Habitats varied considerably, but we found no significant correlation between habitat type, morphology, or color (r_s = 0.078–0.248; P > 0.05). Six individuals were found in primary *Manicaria* swamp forest and two were found in human-made structures within the biological station. A favored area (five individuals) was a riparian stand of mature, introduced Bamboo (*Bambusa* sp.) located in the garden area of the biological station. Here we found a boa that had swallowed a Canadian Wilson's Warbler (*Wilsonia canadensis*), a known winter migrant to the region. Clearly, *C. annulatus* is able to utilize habitats in natural and human-altered situations and, like several other species of *Corallus* (*C. cookii*, *C. grenadensis*, *C. hortulanus*), does not hesitate to exploit man-made structures (Henderson, 2002, Powell et al. 2007).

In addition to the warbler, we observed a small (180 mm SVL) *C. annulatus* feeding on a Brazilian Long-nosed Bat (*Rhynchonycteris naso*) (Lewis et al. 2009). In 2010, one of us (MD) observed a boa consuming a bat in a Rancho-style building at the biological station. This bat was probably also a *R. naso*, as this species was often found in the Rancho, but its identity was not confirmed. To the best of our knowledge, small rodents were previously the only documented prey for wild *C. annulatus* (Henderson et al. 1995). Based on data for other species of *Corallus* (i.e., *C. grenadensis*, *C. hortulanus*, and *C. ruschenbergerii*; Henderson 2002 and papers cited therein), treeboas with SVLs of ~900 mm and longer are largely mammal predators and characteristically exhibit an ambush-foraging strategy, wherein they position themselves low in vegetation above a trail perceived to be used by small mammals. These ambush sites are usually lower in the vegetation when compared to the heights at which smaller boas actively forage for nocturnally quiescent prey (i.e., sleeping lizards and birds). The six *C. annulatus* in our sample with SVLs ≥900 mm (mean = 1037.3 ± 81.6 mm; range = 900–1,434 mm) were encountered at a mean perch height of 208.3 ± 68.7 cm (30–500 cm). In contrast, boas with SVLs <900 mm (mean = 584.1 ± 61.2 mm; 180–874 mm) had a mean perch height of 416.7 ± 84.9 cm (100–900 cm), or twice as high as larger individuals, although perch heights were not significantly correlated with SVL (r_s = -0.198; P > 0.05), probably attributable to our small sample sizes. Based on these data, we suspect that *C. annulatus*, like other species in the genus, is largely a small mammal predator.

Activity in *C. annulatus* was usually minimal upon encounter. Nineteen of the individuals captured, and 23 of the total seen, were found at night, coiled on branches before moving slowly away in an upward direction when approached. Most were detected by their lighter-colored underside and telltale reflective orange eye-shine. Upon capture, many individuals attempted a swift and occasionally successful bite; other defensive behaviors included assuming a balled-up posture, voiding the cloaca, and tail vibration. Nearly all boas appeared to be healthy, with only two possessing small skin lesions or harboring external parasites such as ticks (Acari).

Despite the size of *C. annulatus* and the conspicuous red-orange eye-shine in the beam of a headlamp, only 26 individuals were encountered over a 10-year period, further attesting to the rarity of the species. In contrast, one can observe several other snake species more frequently at Caño Palma Biological Station. For example, 29 Eyelash Vipers (*Bothriechis schlegelii*), 22 Allen's Coral Snakes (*Micrurus alleni*), 13 Blunt-headed Treesnakes (*Imantodes cenchoa*), 13 Clouded Snail-suckers (*Sibon nebulatus*), 4 Ringed Snail-eaters (*Sibon annulatus*), and 4 Red Coffee Snakes (*Ninia sebae*) were observed over a four-month span (AF, unpublished data). We hope that further data collection, only possible over many years of fieldwork, will

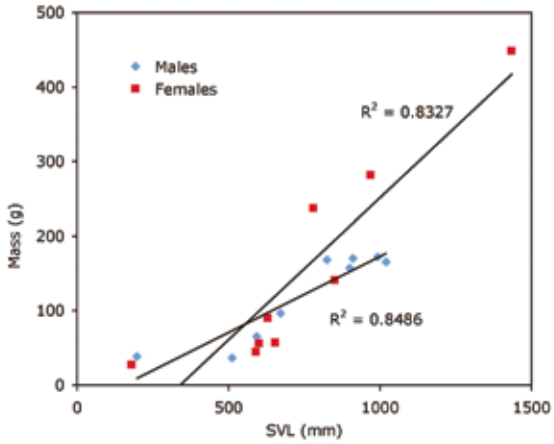

Fig. 8. Plot of snout-vent length (SVL) and mass for male and female *Corallus annulatus* from the Caño Palma Biological Station, 2001–2011.

reveal more of the elusive ecology and natural history of *C. annulatus*. That the species warrants special attention by conservation biologists is supplemental to the more urgent requirement to ensure that both the primary and secondary forests where the species occurs are, or remain, protected for future generations to gather data.

Acknowledgements

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ABBY LINAM

A Texas Horned Lizard (*Phrynosoma cornutum*) from Cottle County, Texas.

The Texas Horned Lizard Watch 1997–2006: A 10-Year Review of a Successful Citizen-Science Program

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Texas Horned Lizards (THL) (*Phrynosoma cornutum*), one of three horned lizard species that occur in Texas, were historically distributed across much of the state, with the exception of the far eastern edge (Price 1990). They have long been popular icons of Texas culture, and many older Texans can recount personal experiences with horned lizards (Manaster 2002, Welch 1993). However, recent studies (Donaldson et al. 1994, Henke 2003), as well as anecdotal accounts, show that THL have declined across much of their range. Concern about declining numbers and over-collection led the Texas Parks and Wildlife Department (TPWD) to list the species as threatened in 1977 (Handbook of Texas Online 2007); however, many uncertainties remain regarding current distribution, causes of decline, and current trends. Because of Texans' fondness for and familiarity with THL, TPWD developed the Texas Horned Lizard Watch in 1996 with the hope that citizen monitors might be able to answer some of those questions about the species.

Methods

TPWD recruits volunteers for the Texas Horned Lizard Watch through press releases, publications such as *Texas Parks and Wildlife Magazine*, and on its web pages. Groups such as Texas Master Naturalist chapters, zoos, nature centers, and the Horned Lizard Conservation Society are specifically targeted for recruitment. The monitoring project is self-directed, with volunteers able to access information on Texas Horned Lizards, descriptions of monitoring protocols, and data sheets in a free monitoring packet, both in printed form (TPWD 2001) and online (www.tpwd.state.tx.us/hornedlizards/). Volunteers also choose their own survey locations. Volunteers are not required to undergo training; however, in recent years, TPWD has offered optional workshops to groups interested in learning more about Texas Horned Lizards or in expanding the scope of the data collected.

Volunteers can choose to participate in the Texas Horned Lizard Watch at three different levels. The most intensive level consists of surveying transects to collect quantitative data on Texas Horned Lizard and ant density. Participants walk or slowly drive the transect, counting THL seen and red imported Fire Ant (RIFA) (*Solenopsis invicta*) and Harvester Ant (*Pogonomyrmex* sp.) beds in a 2-meter-wide belt. Following the first year of the project, when variability in transect data submitted was extremely high, volunteers were encouraged to set a minimum length of 4.8 km for transects. Most participants choose a less rigorous approach, Adopt-a-Habitat, in which they adopt sites, such as a ranch, backyard, or local park, and provide more qualitative information about the presence or absence of THL and habitat variables. Because sizes of these adopted sites vary greatly, data from sites are not converted to density estimates. Volunteers are encouraged to collect data on transects or sites at least three times between May and August, and also are asked to record descriptions of habitat, land use, soil type, ant species present, date, time, and temperature. Participants can also participate as a Texas Horned Lizard Spotter, in which they report incidental sightings of THL wherever they occur. Volunteers are encouraged to submit photographs of THL seen, but are not required to do so.

Data also are gleaned from emails and telephone calls that come into TPWD (data are confirmed through follow-up contact, such as a request for a photo or description of the animal) and from research projects, as available. Data are summarized annually and provided to volunteers in an annual report, along with a year-specific token of appreciation. Results also are published in an annual program newsletter.

Results

Participation.—From 1997–2006, 186 volunteers submitted data to the program using official data sheets. The number of volunteers formally participating in the watch program has varied since its inception, with a peak of 71 in 1999 (Fig. 1) and a general decrease in participation since then. Publicity for the watch was highest in its initial years — that publicity and the novelty of the program probably produced the increased participation in those years. The vast majority of volunteers participate only one year (Fig. 2); however, three volunteer teams participated in all 10 years. Success in seeing a THL does not seem to influence whether or not volunteers continue to participate. A total of 270 sites were monitored via transects or site visits. Data were submitted from 165 of 254 counties. Texas Horned Lizards were reported from 146 of those counties.

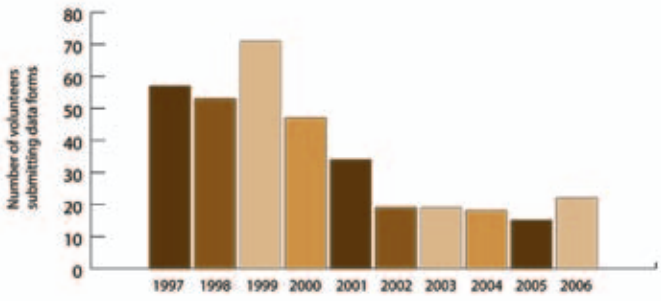

Fig. 1. Volunteer participation in the Texas Horned Lizard Watch, 1997–2006.

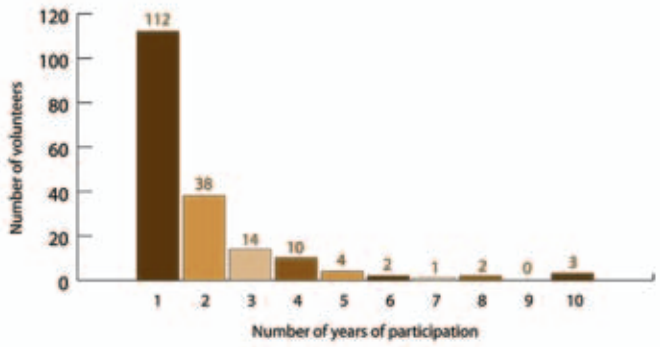

Fig. 2. Number of years of participation by Texas Horned Lizard Watch volunteers, 1997–2006.

Prevalence.—A map of THL prevalence based on ten years of data from the Texas Horned Lizard Watch (Fig. 3) reveals a complex pattern of distribution. Project data indicate that THL are apparently rare in the Coastal Prairie region of Texas, although they persist in sandy soils of some coastal counties where volunteers have sighted them on barrier islands and in coastal ridge habitat. Moving inland, THL are still regularly reported from counties within the Post Oak Savannah ecoregion. These counties are characterized by sandy soils and less intensive agriculture. Few reports have been received from the Pineywoods (Fig. 4), perhaps due to historic as well as current scarcity of THL. THL appear to be rare in a belt that follows

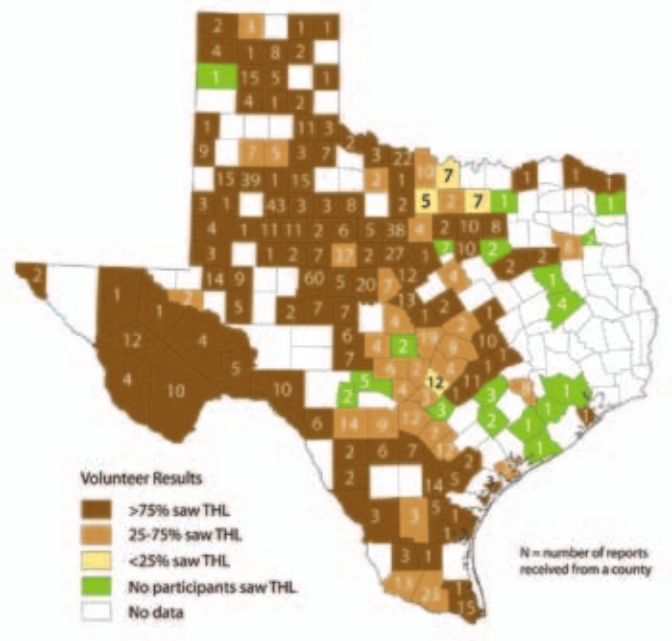

Fig. 3. Texas Horned Lizard prevalence based on Texas Horned Lizard Watch results, 1997–2006.

the counties of the IH-35 corridor north from San Antonio. Urbanization, intensive agriculture in Blackland Prairie soils, and prevalence of RIFA may be associated with declining trends in this region. One puzzling exception is Tarrant and Dallas counties, where 15 sightings have been made in the past decade. Further investigation is warranted in this area to rule out misidentifications and the possibility of local releases. Results are mixed in the Rolling Plains and Edwards Plateau ecoregions, with volunteers in some counties reporting THL present and volunteers elsewhere, especially those in the more eastern edge, reporting that THL have not been seen in many years. Urbanization and Fire Ants may be exerting local effects on populations. Texas Horned Lizards are prevalent in much of the South Texas Brush Country, although some declines are reported along the northern edges of this ecoregion, roughly following US 90 and IH-37. Declines also have been reported for many years in the Lower Rio Grande Valley, presumably associated with urbanization and intensive agriculture, although THL still can be commonly encountered in this region. Finally, West Texas remains the stronghold for the species. THL are still widely reported from the High Plains and the Trans-Pecos, although the species is reported to be less abundant in many urban areas.

Habitat Characteristics.—Some volunteer data indicate a relationship between the presence of THL and ant species. Presence/absence data show a relationship between the presence of Texas Horned Lizards and the presence of Harvester Ants, their preferred food source (Fisher's exact test, 2-tailed, P = 0.03). Similarly, the presence of THL is not independent of the presence of RIFA (P = 0.0002). Texas Horned Lizards are more likely to be present where Harvester Ants are found and less likely to be present

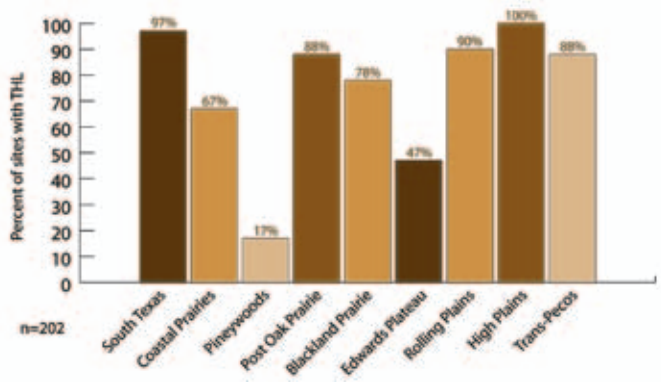

Fig. 4. Percent of sites reporting Texas Horned Lizards by ecoregion, 1997–2006.

where Fire Ants are found (Fig. 5). The presence-absence relationship with RIFA is not as strong when counties outside the distribution of RIFA are excluded (P = 0.06), perhaps due to smaller sample sizes or other regional effects; although ecoregion in itself is not statistically correlated with THL presence-absence. When data from transects are examined using multiple regression, densities of RIFA and densities of Harvester Ants are good predictors of the density of THL (r^2 = 0.70), with a negative effect from RIFA and a positive effect from Harvester Ants.

Volunteers also provided data on land use and habitat. Overall, THL were reported most often from lands that were used for residential areas or for ranching (Fig. 6), likely reflecting a tendency of volunteers to monitor these types of habitats. Pooled data collected between 1998 and 2006 do not indicate that THL presence is related to land use; however, volunteers did tend not to sample some habitats (such as agriculture and parkland). During the sampling period, THL were found most often in native grassland, mixed grass, and shrub communities, or in improved grasslands (Fig. 7); however, these habitat differences were not statistically significant. THL were reported from sand, clay, and loam soils, with no measurable effect from soil type (Fig. 8).

Characteristics of Sightings.—Although not required, many watchers reported approximate size information for THL (Fig. 9). Sizes ranged from less than 2.5 cm to over 15 cm, with the 10.2–12.7 cm size class reported most frequently. Lizards were sighted most frequently in June, July, and May, with even a few rare winter sightings (Fig. 10). Young lizards (<2 cm) were seen most often in July and August. Lizards were most often seen when temperatures were between 27 and 32 °C (Fig. 11), although sightings might reflect some bias against extremely high temperatures on the part of observers. Several THL were spotted at temperatures >38 °C, and several were spotted when temperatures were <21 °C.

A Texas Horned Lizard on its preferred sandy substrate in Cottle County, Texas.

Trends.—While results of the Texas Horned Lizard Watch have shed some light on distribution patterns and on the effects of habitat variables, survey results have not managed to reveal a trend in THL populations over the ten years of the survey. Density estimates from transects surveyed by volunteers do not reveal trends in THL or ant abundance, but sample sizes were small.

Qualitative data also do not provide insight into trends. Only three sites were monitored continuously from 1997 to 2006, with no change in presence or absence noted at these sites. Because of a high turnover in volunteer participation, a mail survey was conducted in 2007 seeking updated data on 162 monitoring sites that were established in 1997–99. Volunteers were asked if they had revisited the sites within the last three years and whether Texas Horned Lizards had been seen at the site. Responses were received for 66 sites, with updated sighting data provided for 47 sites. Only 13 sites reported that their results had changed in the last decade, with 11 of the 13 reporting THL were originally present but now absent. Some geographic patterns might be evident (Fig. 12), but sample sizes are too small to draw definitive conclusions. When asked their opinions about trends, 40% of the original participants thought THL were decreasing, 24% thought populations were stable, 16% thought they had increased, and 20% were unsure.

Finally, in an effort to increase sample sizes for recent years, an email survey of Texas Parks and Wildlife Department wildlife biologists was conducted in 2007. Biologists were asked if they had seen a Texas Horned Lizard in their counties of responsibility in the past three years. Results showed a definite geographic break, with no sightings in the eastern third of Texas (except for some coastal counties) and sightings in nearly every county of West and South Texas (with the exception of the southern edge of the Edward's Plateau). While results corroborate positive volunteer results in West and South Texas, they failed to confirm the positive volunteer findings in the Post Oak Savannah and the Dallas-Fort Worth area. Several of these volunteer reports have been confirmed by photographs or personal observation; however, Texas Horned Lizard populations may be so small and scattered in these counties that encountering them is unlikely unless a person lives in those specific habitat areas.

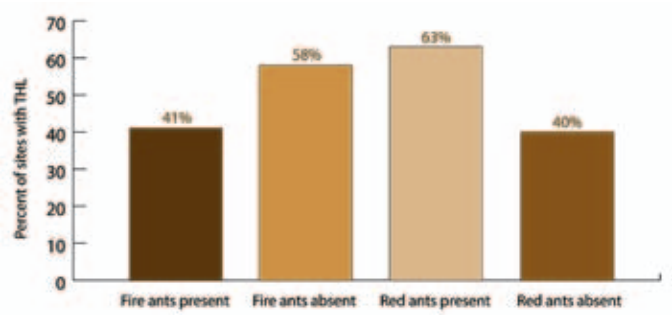

Fig. 5. Texas Horned Lizard presence versus ant species presence; Texas Horned Lizard Watch, 1998–2006.

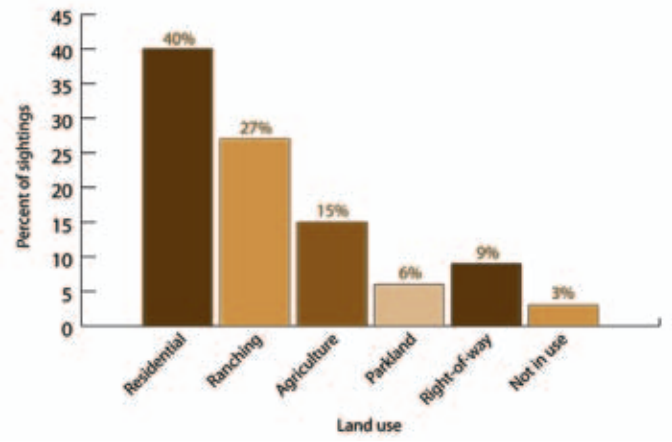

Fig. 6. Land use where Texas Horned Lizards were sighted; Texas Horned Lizard Watch, 1997–2006.

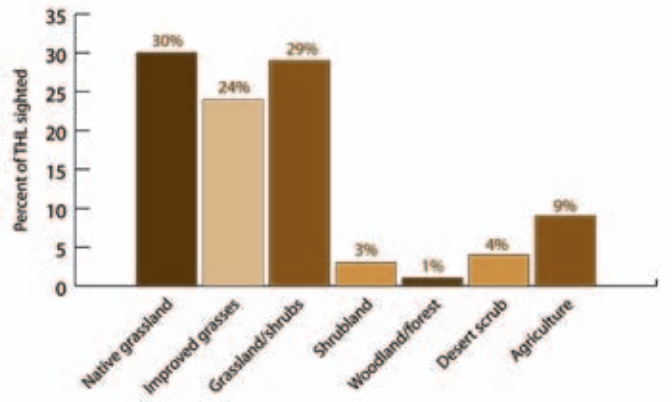

Fig. 7. Habitat types where Texas Horned Lizards were found; Texas Horned Lizard Watch, 1997–2006.

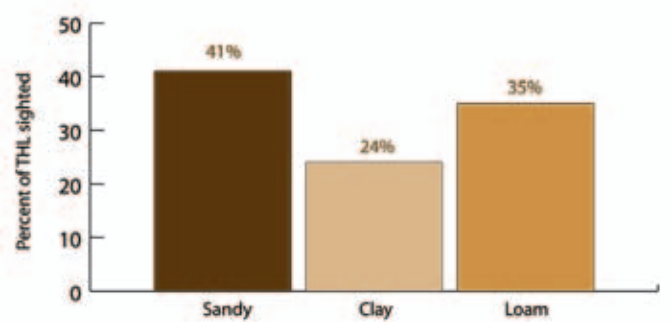

Fig. 8. Soil types where Texas Horned Lizards were found; Texas Horned Lizard Watch, 2000–6.

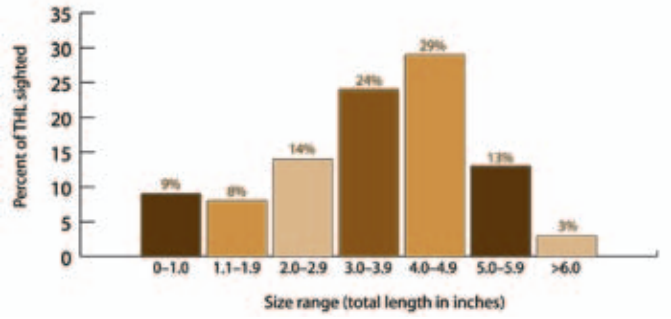

Fig. 9. Size classes reported for Texas Horned Lizards found during the Texas Horned Lizard Watch, 2000-6.

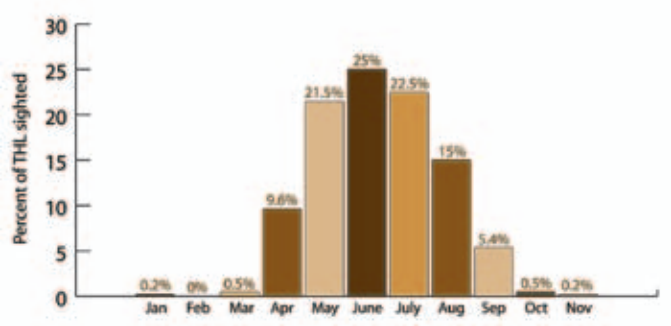

Fig. 10. Dates of Texas Horned Lizard sightings; Texas Horned Lizard Watch, 2000–6.

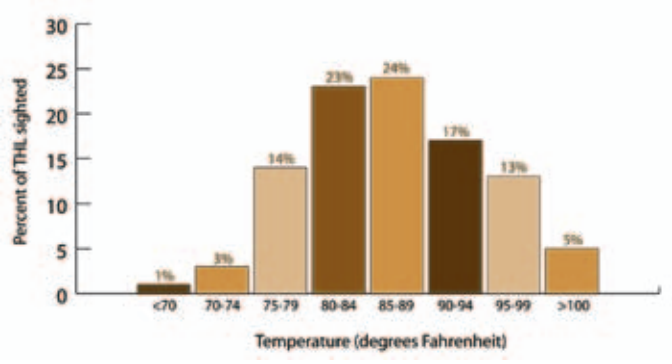

Fig. 11. Temperatures when Texas Horned Lizards were sighted; Texas Horned Lizard Watch, 2000–6.

Conclusions and Recommendations

Although volunteers have been engaged in scientific investigations for decades (Bonney et al. 2009), standards for the field of citizen science, such as those in Prsyby and Super (2007) and analyses of success have only recently appeared in the literature. Citizen-science herpetological projects are even more recent (e.g., Price and Dorcas 2011). The findings of the Texas Horned Lizard Watch, launched in 1997, reflect many of the lessons learned in this newly emerging field.

During its initial 10 years, the THLW produced both public enthusiasm and insightful results. One notable accomplishment is an ongoing refinement of the current distribution map for the species. Whereas recent scientific surveys (Donaldson et al. 1994, Henke 2003) and our survey of TPWD biologists produced pessimistic results for the eastern third of the state, our project volunteers provided encouraging results from the Post Oak Savannah ecoregion, the barrier islands of coastal counties, and perhaps the Dallas-Fort Worth Metroplex. As a result of citizen sightings, research is now underway to understand the viability, genetic characteristics, and habitat attributes of these populations. Because volunteers often spend more time "on the ground" at their monitoring sites than formal scientific studies allow, they have the potential to continue to fill in the gaps of the species' distribution.

The THLW also has provided some insight into habitat relationships for the species based on simple presence/absence data. Most notably, volunteer results show a clear relationships between the presence of red imported Fire Ants and THL. Previous work postulated that RIFA have negatively impacted THL (Allen et al. 2004, Donaldson et al. 2004, Henke 2003), but our first five years of volunteer data were the first to demonstrate a statistically significant negative relationship between the two. RIFA might not have been the primary factor contributing to THL declines; however, these findings suggest that recovery efforts will have to address their management in order to be successful. Some years of data have implied a relationship between THL and land use or soil type, but, in contrast to suggestions by Donaldson et al. (2004), our pooled data do not reveal a clear connection. More conclusive results for these variables are probably limited by small data sets from some land-use types, as well as a tendency for volunteers with negative results to not submit data sheets. In order to encourage data submission from non-occupied habitat, the TPWD has recently implemented an annual incentive award for participation. Participants now will have an opportunity to earn an award each year, whereas previous awards were based on multiple years of participation. At the same time, incentive

JOHN A. ENGLISH

The Texas Horned Lizard Watch has documented a positive relationship between the presence of lizards and that of Harvester Ants (*Pogonomyrmex* sp.), which when present are the principal prey of Texas Horned Lizards. This is clearly evident from this scat packed with the remains of Harvester Ants.

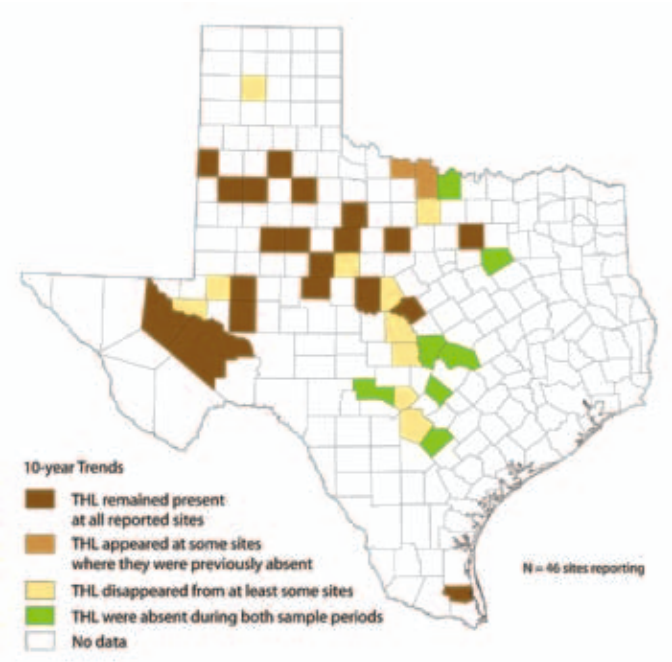

Fig. 12. Trends in Texas Horned Lizard sightings; Texas Horned Lizard Watch, 1996–8 versus 2005–7.

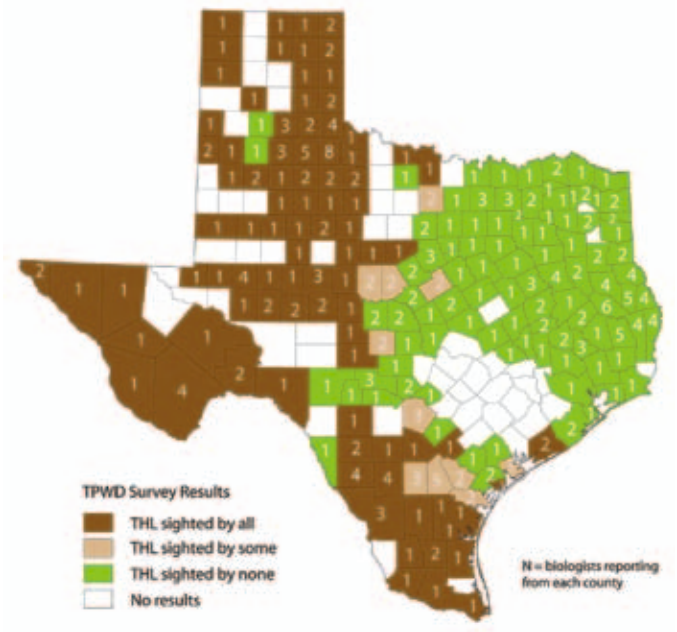

Fig. 13. Occurrence of Texas Horned Lizard sightings by Texas Parks and Wildlife Department Biologists, 2004–6.

rewards will be reserved for monitors that meet minimum sampling standards, which have been raised from three to five times per year.

The watch program has not fulfilled all initial expectations. The TPWD had hoped that the monitoring program might provide a quantitative measure of THL abundance over time. Initial results showed that, as initially implemented, when resources were not available for volunteer training, quantitative measures by so many different volunteers were highly variable. Furthermore, ongoing research shows that sampling must be intensive to detect changes in density of THL (C. Ruthven, pers. comm.). When a minimum transect length of 4.8 km was adopted, regression analyses of those longer transects did show some density relationships between horned lizards and ant species. In order to recruit more participants to submit these types of quantitative data, the TPWD has begun to offer workshops for the THLW in which transect sampling and more detailed habitat sampling techniques are taught. Audiences for these workshops include Texas Master Naturalists, who are highly motivated to be involved in more rigorous scientific studies. In addition to incentive rewards, participants in such workshops will be listed as sub-permittees on a scientific permit for the THLW, an additional source of motivation for some volunteers.

An additional challenge is that most volunteers do not choose to continue monitoring year after year — leading to "snapshot" rather than trend data. When contact was re-established with some of the early volunteers in 2007, many indicated that they would be willing to participate again. More frequent contact might increase retention and shed more light on trends. In the hope of encouraging both continued and new participation, the TPWD is in the process of making data entry available online. The online portal will also allow submission of digital photographs, increasing the quality assurance for data from volunteers who have not been through formal training, and will track survey hours to allow some measure of survey effort. As with many self-directed citizen science projects in which sampling points are not randomly selected, trends may not be applicable across the range of the species (Bonney et al. 2009), but still can serve to identify sites for further investigation by the TPWD.

On the whole, the THLW has been successful in its attempt to engage citizens in meaningful, hands-on research. Participants are overwhelmingly enthusiastic, with many offering much more information and research than requested. Personal recollections offered by watch participants were the inspiration for an essay contest called "Hometown Horned Toads," conducted from 2001 through 2006, which was designed to encourage students to capture oral histories about people's experiences with THL and observations of their decline. Such educational experiences are one of several benefits of citizen-science programs (Cohn 2008). The results of the THLW have been more than poignant and educational; they have been significant. Distribution data have been used in project planning and environmental reviews, and habitat relationships have been used to advise management. The project will be continued and modified in future years to increase participation, especially in quantitative sampling; to assess trends through maintaining contacts with initial participants; and to incorporate data on the other two horned lizard species in Texas.

LEE ANN JOHNSON LINAM

Eighth-grade students in Bastrop County studying Texas Horned Lizard habitat.

LOU HAMBY

A Texas Horned Lizard assuming a defensive posture near Carrizo Springs, Dimmit County.

Acknowledgements

Only the unique love of Texans for this unique species has made this research effort possible. I thank, first and foremost, the volunteers who have participated in the Texas Horned Lizard Watch and the landowners who provided access for these volunteers to their property. Special recognition goes to Britton and Gayle Phillips, Beverly Kitzman, and Ed, Linda, and Anna Allen, who provided data during all of the first ten years of the watch program. Appreciation also is expressed to Chip Ruthven and Andy Price for their suggestions in project design and editing of project materials, to Priya Nanjappa for early reviews of this manuscript, to Chris Hunt for graphics production, and to Marsha May for her continual assistance in project management and promotion. Funding support for the initial years of the project was provided by the U.S. Fish and Wildlife Service. The Horned Lizard Conservation Society also has provided ongoing support in promoting the goals of the Texas Horned Lizard Watch.

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MICHAEL G. MITTERMEIER

An adult *Epicrates striatus strigulatus*, a subspecies of the Hispaniolan Boa native to the Bahamas, held captive at the Island School at Cape Eleuthera on South Eleuthera, Bahamas constricting and consuming a Bahamian Racer (*Cubophis vudii*).

Consumption of Bahamian Racers (*Cubophis vudii*) by a Boa (*Epicrates striatus strigulatus*) in Captivity

Michael G. Mittermeier

Collegium of Natural Sciences, Eckerd College, St. Petersburg, Florida 33711, USA (mgmitter@eckerd.edu)

From 26 March to 5 June 2010, an adult *Epicrates striatus strigulatus*, a subspecies of the Hispaniolan Boa native to the Bahamas, was held captive at the Island School (www.islandschool.org/) at Cape Eleuthera on South Eleuthera, Bahamas. Because finding rodents or other small mammals was difficult, this snake initially (on 29 March) was given and readily consumed small birds (e.g., Common Ground Doves, *Columbina passerina*). Later, small Bahamian Racers (*Cubophis vudii*), as many as three or four at a time, were placed in the cage with a hide-box, and "disappeared." Subsequently, on 8 April and again on 21 April, the snake was observed eating racers. On one occasion, a smaller *E. striatus* was placed in the cage, and also was consumed.

Hispaniolan Boas are opportunistic feeders (e.g., Henderson and Powell 2009) known to eat frogs, lizards, birds, and mammals (Sheplan and Schwartz 1974; Henderson et al. 1987; Schwartz and Henderson 1991; Franz et al. 1993; Knapp and Owens 2004; Knapp et al. 2004, 2005). Hanlon (1964) reported cannibalism by a female of her brood in captivity.

Boas and racers are unlikely to encounter each other in nature. Boas are nocturnally active, whereas racers are diurnal, limiting possible interactions to crepuscular periods or when an actively foraging boa or an individual establishing an ambush position happens upon a sleeping racer. Nevertheless, consumption of other snakes in nature or captivity has not been previously reported for this species or any West Indian congeners.

Acknowledgments

I thank the Island School for the opportunity to carry out herpetological research while a student. Luke Sasek contributed to the original study and provided dates included in this note. Thanks also to Alex Henderson who helped care for the snake. Special thanks to Robert Powell and Robert W. Henderson, whose comments on early drafts of this note were quite helpful.

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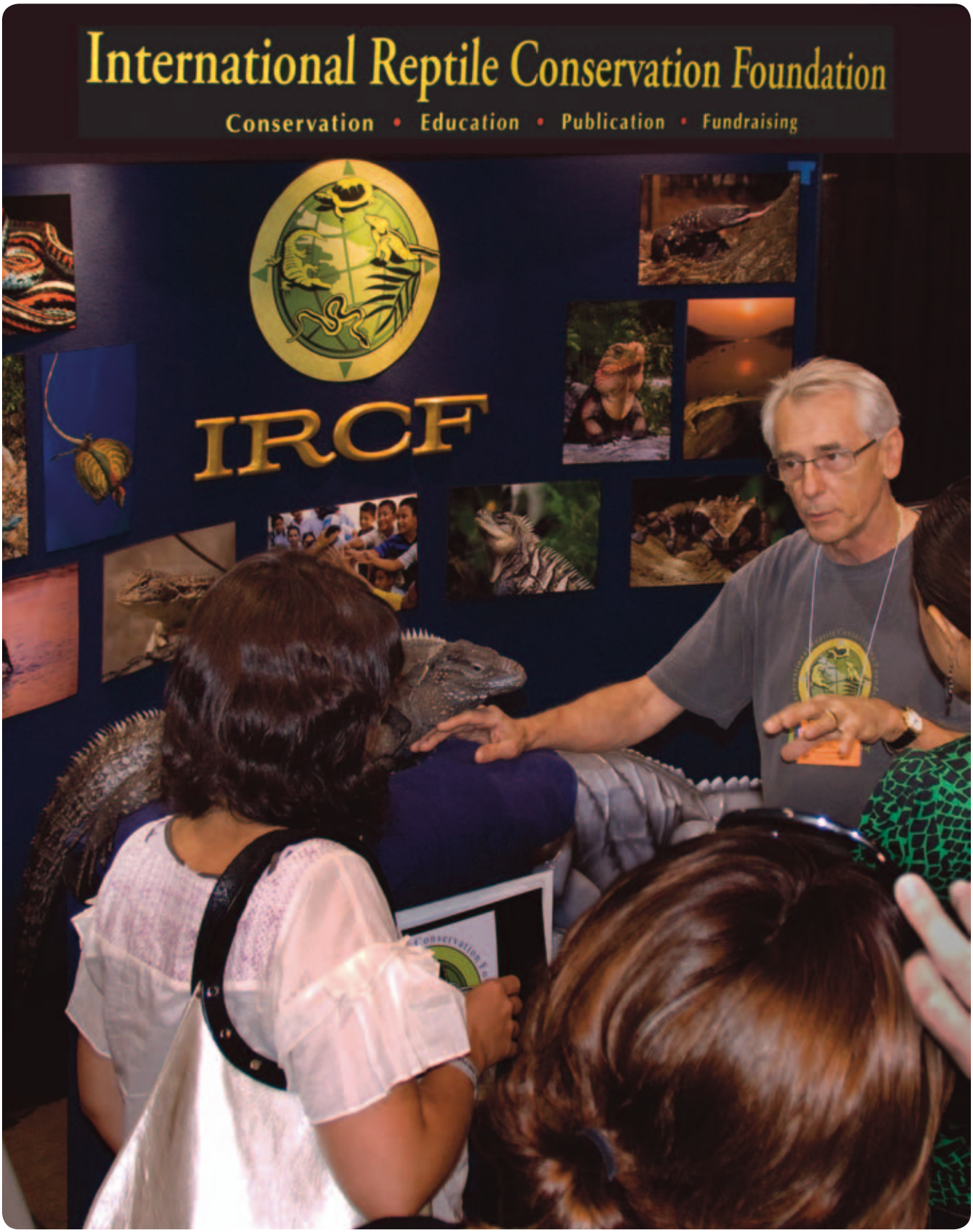
LUKE SASEK

Like most West Indian boas, *Epicrates striatus strigulatus* feeds almost exclusively on lizards (mostly anoles) when small, and then shifts to endothermic prey as it gets larger.

LUKE SASEK

The same captive *Epicrates striatus strigulatus* eating a Common Ground Dove (*Columbina passerina*).



DESIREE WONG

John Binns, founder and CEO of the IRCF, and Izzy the Cuban Iguana (*Cyclura nubila nubila*) focus their audience's attention on the conservation of Rock Iguanas (*Cyclura* spp.) of the West Indies. Many of these species are among the most endangered reptiles on earth, threatened by human-mediated destruction of their island habitats, predation from invasive mammals, and competition with introduced mammalian herbivores.

The International Reptile Conservation Foundation: Critical Help for Endangered Species and Habitats

AJ Gutman

International Reptile Conservation Foundation (aj@ircf.org)

In small classrooms throughout the Motagua Valley of Guatemala, Mojado and his handler, Antonio Urbino, are popular visitors. Mojado is a teaching lizard, comfortable with being handled even by children, and he is here to represent the critically endangered Guatemalan Beaded Lizards (*Heloderma horridum charlesbogerti*) that are endemic to the valley. If his species is to survive, it needs the cooperation and understanding of an educated and environmentally aware public. In a larger town in the U.S., a large Rock Iguana (*Cyclura* spp.) named Izzy draws an audience to help educate people about the International Reptile Conservation Foundation (IRCF) and its mission to conserve reptiles and amphibians (like Mojado and his kin) and the natural habitats and ecosystems that support them. Izzy is only one of a number of "spokeslizards" who regularly attend reptile shows and conventions across the U.S. on behalf of the IRCF to teach, solicit donations for the broad range of conservation programs it helps to support, and invite new members to join the organization.

International Reptile Conservation Foundation

The IRCF, founded in 2001, is a member-based, not-for-profit organization headquartered in Tucson, Arizona that takes a pragmatic approach toward conservation. "Many of the species we seek to help are faced with imminent critical risk to their very existence, and sometimes providing the right kind of help at the right time can make all the difference," says John Binns, founder and CEO of the IRCF. "We can and have responded to emergency situations, and we can also provide assistance to smaller projects

JOHN BINNS

In a Guatemalan classroom, Antonio Urbino and Mojado, the Guatemalan Beaded Lizard (*Heloderma horridum charlesbogerti*), are part of a successful education and awareness program sponsored by the Disney Wildlife Conservation Fund. Although the Guatemalan Beaded Lizard is one of only two venomous lizard species, it need not pose a danger to humans. Students are taught not to interfere with the endangered lizards should they be encountered in the wild.

that wouldn't necessarily come to the attention of some of the larger conservation organizations. We're always on the lookout for ways in which we can make a difference."

In many ways, the IRCF serves as a shared back office to many field-based conservation efforts. This allows the people in the field to focus on what they do best — helping species recover through direct conservation activities — while the IRCF focuses on other key functions such as fundraising, communications, and volunteer coordination.

Internet development is one of the Foundation's greatest strengths, providing a vehicle for global outreach for its partners without that capability. Aside from disseminating information, soliciting donations, and enlisting volunteers, websites hosted and maintained by the Foundation provide e-Commerce options for conservation fundraising through the sale of specialized merchandise. The Foundation also enables the production of books, posters, and brochures to help increase awareness of species threatened with extinction.

Reptiles & Amphibians keeps its readers abreast of the most pressing conservation issues, such as the Global Amphibian Crisis, through research articles, Conservation Alerts, and a Focus on Conservation feature.

Leading nature photographer and ecologist Thomas Wiewandt, an IRCF member and advisor, believes that the IRCF's independent status is a great asset: "The IRCF was created to give conservation initiatives a voice independent of institutional politics and conflicting agendas. This doesn't mean, however, that the IRCF works alone. In fact, one of its strengths is its ability to partner and work effectively with many organizations in developing and implementing species recovery plans as part of the total conservation solution."

Reptiles & Amphibians

The IRCF's strongest conservation tool has always been its quarterly journal, *Reptiles & Amphibians: Conservation and Natural History*. The journal features 64 full-color pages with centerfold and comes with the IRCF membership. A typical issue features articles about current research and updates on conservation projects, travelogues, book reviews, provocative commentaries, and profiles of important figures in the herpetological community. Most importantly, readers are kept abreast of critical conservation needs through "Conservation Alerts" and the "Focus on Conservation." Contributors to *Reptiles & Amphibians* come from as broad a range as its readers, and include hobbyists, zoo-based professionals, field researchers, and scientists from all levels of academia. All articles are now peer-reviewed. A recent addition to the journal has been an Introduced Species section to document the presence of non-native species of reptiles and amphibians to

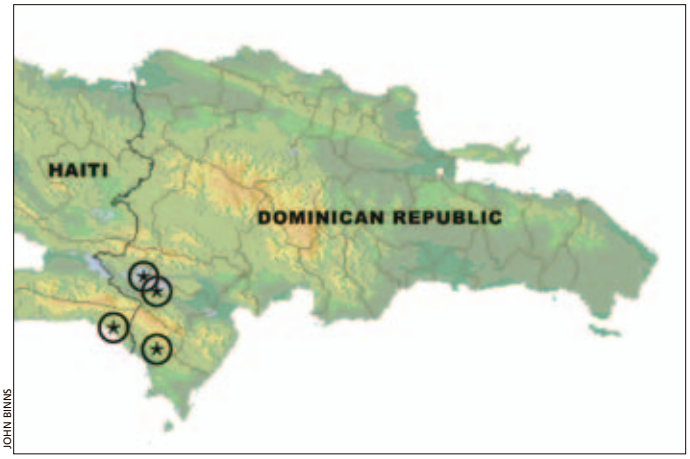
Checklists for particular geographic areas provide important data on native and introduced species of reptiles and amphibians.

Readers responded enthusiastically to *Reptiles & Amphibian's* four-part tribute to naturalist Henry S. Fitch, who died in 2009, just shy of his 100th birthday. Fitch was known as the "father of snake ecology" and to highly value field observations.

areas where they do not naturally occur. Identifying the mechanisms and outcomes of these events provides information that regulators can use to address and moderate the problem. The situation is of particular concern on many islands, where endemic species are threatened by competitively superior continental invasives.

Ricord's Iguana (*Cyclura ricordii*)

The Caribbean island of Hispaniola comprises two countries, the Dominican Republic (DR) and Haiti; it also is home to two species of Rock



JOHN BINNS

Ricord's Iguanas (*Cyclura ricordii*) are known from only four isolated populations: The south side of Lago Enriquillo, Isla Cabritos, and Pedernales in the Dominican Republic, and from the newly discovered population in Anse-a-Pitres, Haiti.

JOEL FRIESCH

The legend on this T-shirt design by Joel Friesch is in Kreyòl. In English, it means "Let's Protect Ricord's Iguanas."

JOHN BINNS

In Haiti, Ricord's Iguanas are threatened largely by human activities such as habitat destruction, hunting for consumption, and nest poaching.

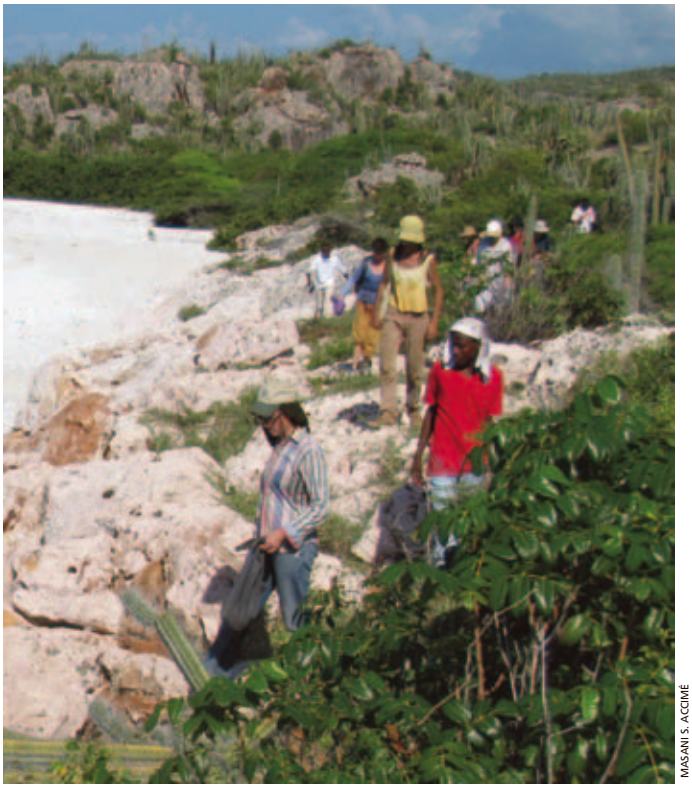
JOHN BINNS

Rhinoceros Iguanas (*Cyclura cornuta*) live sympatricaly with Ricord's Iguanas on Hispaniola, but because their habitat requirements are less specific, Rhinoceros Iguana populations are not quite as threatened as those of their congener.

Iguanas: the Rhinoceros Iguana (*Cyclura cornuta*), and Ricord's Iguana (*C. ricordii*). The latter is known only from three small and disconnected remnant populations in the DR and a newly discovered population in Haiti. Red-listed as Critically Endangered by the IUCN, the once wide-ranging habitat of these large ground dwellers has been largely destroyed by agriculture, limestone mining, and cattle that compete for the limited vegetation and trample iguana nests. The animals are also hunted for food and preyed upon by introduced cats, dogs, and mongooses.

MASANI S. ACCIMÉ

A research team member examines a wild Ricord's Iguana hatchling in the study area.



MASANI S. ACCIMÉ

Ricord's team members trek through Ricord's Iguana habitat in Anse-a-Pitres, Haiti.

The IRCF is a long-time supporter of the Dominican NGO Grupo Jaragua that is spearheading conservation efforts for Ricord's and Rhinoceros iguanas, with major funding provided by the U.S. Fish and Wildlife Service and the International Iguana Foundation. The IRCF participated in the IUCN Iguana Specialist Group's workshop to develop a Species Recovery Plan, which prioritizes conservation actions necessary to ensure the long-term survival of Ricord's Iguana. The plan is based on research, particularly of the ecological needs of the species, public awareness, captive breeding, and a future management plan for a series of protected areas.

For the newly discovered population of Ricord's Iguanas in Haiti, education and awareness are key to engaging the goodwill and cooperation of the surrounding community, and a crucial role is played by a local youth group that actually participates in population surveys and radio-tracking. These young people proudly wear T-shirts with a drawing of the endangered Ricord's Iguana perched atop the outline of their country, a logo that was created by IRCF artist Joel Friesch. Thanks in part to sponsorship by Exo Terra, the IRCF is helping to fund portions of the educational program in Haiti, including compensation for local field staff, equipment, major graphic support for educational material, telecommunications, and local transportation expenses. The IRCF is seeking donations to expand its support in Haiti and for its other supported programs.

Grand Cayman Blue Iguana
(*Cyclura lewisi*)

One of the most successful projects supported by the IRCF has been on behalf of one of the most endangered West Indian Rock Iguanas, the Grand Cayman Blue Iguana, *Cyclura lewisi*, Red-listed as Critically Endangered by the IUCN. Triggered by a 2002 survey that revealed a mere 20–25 individuals remaining in the wild, the IRCF and the Durrell Wildlife Conservation Trust helped establish the Blue Iguana Recovery Program (BIRP), a key component of which has been the captive breeding and head-starting of Blue Iguanas for release to protected areas in the wild.

BIRP has faced innumerable challenges and setbacks and had many lessons to learn before achieving a degree of success. The IRCF has been

JOHN BINNS

The Grand Cayman Blue Iguana (*Cyclura lewisi*) occurs only on Grand Cayman Island. The Sister Isles Rock Iguana (*Cyclura nubila caymanensis*) is endemic to neighboring Little Cayman and Cayman Brac.

FRED BURTON

The Blue Iguana Recovery Program head-start enclosures. Directly behind these enclosures are the spacious pens for the breeding pairs. Other pens, enclosures, and the facility shed are located elsewhere on the property. The program offers daily guided tours of the facility. Visitors learn how the Blue Iguana has been saved from certain extinction and about the recovery program that works to secure the population for the long term.

JOHN BINNS

One of the few remaining wild Blue Iguanas (*Cyclura lewisi*) captured several years ago along the Queen's Highway on the north side of Grand Cayman. This large female named "Vegas" is a valuable genetic asset to the breeding program. She recently produced a viable clutch of 17 eggs.

there every step along the way, helping with fundraising, web hosting and design, education and awareness campaigns, and many hands-on contributions. Since 2005, when the first "Team Blue" was recruited and sent to Grand Cayman with hammer and nails to assist in an upgrade of the captive-breeding facility, the IRCF has been organizing volunteers from its membership to assist with everything from facility work to release and radio-tracking of individuals in the wild. Today, after years of hard work, close to 500 captive-raised individuals have been released into the 235-ha Salina Reserve and a newly established second protected area, the 77-ha Collier's Wilderness. A species once functionally extinct in the wild now has a realistic chance of surviving, yet many challenges lay ahead before the program's mission of restoring a stable population of 1,000 Blue Iguanas to the wild can be deemed a complete success.

Guatemalan Beaded Lizard
(*Heloderma horridum charlesbogerti*)

The Motagua Valley of Guatemala, with its unique semiarid climate, subtropical thorn scrub, and dry forests, has been recognized by the World Wildlife Fund as a unique eco-region under siege. It is also home to the critically endangered Guatemalan Beaded Lizard (*Heloderma horridum charlesbogerti*). The species' habitat is being destroyed by the expansion of agriculture, the lizards have traditionally been killed on site by local people who believe they are dangerous, and individuals are being collected illegally for the international pet trade. The remaining wild population of Beaded Lizards has plummeted to fewer than 200 individuals.

15, 17, & 18 FRED BURTON | 16 JOHN MAROTTA

A series of photographs that depict the primary purpose of the program (from left to right): Breeding, egg collection, husbandry and head starting, and release in the wild. Blue Iguanas released in the Salina Reserve are reproducing; hopefully iguanas being released into the Collier's Wilderness Reserve will also breed. The Blue Iguana Recovery Program relies on local and international volunteers to manage all the duties at the facility and to aid in fieldwork in the extreme and treacherous terrain of the reserves. The IRCF recently published the "*Little Blue Book*" by Fred Burton, which tells the story of the Blue Iguana and its natural history. This hardcover book is heavily illustrated in full color and available on the IRCF website.

ZOOTROPIC

The IRCF-funded utility vehicle used by Zootropic for Project Heloderma, Project Palearis, and others.

JOHN BINNS

The Motagua Valley, Guatemala. The marker shows the location of the Heloderma Natural Reserve. Conservation efforts for the Guatemalan Spiny-tailed Iguana (*Ctenosaura palearis*) occur in this same area.

Project Heloderma was initiated in 2006 by Guatemalan NGO Zootropic, and later joined by key partners, the IRCF and Zoo Atlanta, to save the Guatemalan Beaded Lizard from extinction. Aspects of the project include ongoing field research, an education and awareness program that has been successful within the species' natural range and hopes to expand, and the establishment of a system of protected areas. Thanks to the project, *Heloderma horridum charlesbogerti* is now listed under CITES Appendix I. An initial parcel of land was purchased in 2007. The protected area, known as Heloderma Natural Reserve (HNR), now covers 128 ha (317 acres) and hopes to further expand to proportions capable of supporting a viable population of Beaded Lizards. In the meantime, captive-breeding of *H. h. charlesbogerti* remains a top priority for preservation of the species in the short term and is one of the primary purposes of the Research and Captive

MICHAEL KERN, ANIMAL COURTESY OF ZOO ATLANTA

Guatemalan Beaded Lizard (*Heloderma horridum charlesbogerti*).

THOMAS SCHREI

Habitat of the critically endangered Guatemalan Beaded Lizard (*Heloderma horridum charlesbogerti*) is being destroyed by agricultural development while lizards are killed on sight or collected illegally for the international pet trade.

JOEL FRIESCH

T-shirt artwork created by Joel Friesch depicting *Ctenosaura palearis* and *Heloderma horridum charlesbogerti* that says: "The Guatemalan Beaded Lizard and the Guatemalan Spiny-tailed Iguana. Pride of the Motagua Valley! Protect them!" T-shirts were distributed in local schools as part of the educational program.

Breeding Facility that began its first phase of operations early this year. As funds allow the centre to expand, the breeding and research functions will increase in scope and the facility hopes to become a hub for environmental education in the Motagua Valley and an anchor for the preservation of the many unique species of flora and fauna found in the dry forest habitat.

Guatemalan Spiny-tailed Iguana
(*Ctenosaura palearis*)

Eighteen species of Spiny-tailed Iguanas (*Ctenosaura* spp.) have been described — but the conservation status of most is unknown, largely attributable to a lack of research. The IRCF recently helped produce an illustrated guide to ctenosaurs for the U.S. Fish and Wildlife Service to help inspection officials identify animals and assist with the enforcement of national conservation laws.

One endangered ctenosaur species that has been the subject of intense research efforts inhabits the same few remaining patches of dry forest in Guatemala's Rio Motagua Valley as the Guatemalan Beaded Lizard. On behalf of the Guatemalan Spiny-tailed Iguana (*Ctenosaura palearis*), Project Palearis was initiated by Zootropic, at the suggestion of the IRCF and Zoo Atlanta, to operate in tandem with Project Heloderma and take advantage of the same research and education programs and protected areas. Aside from threats to the habitat that *C. palearis* shares with the Beaded Lizard, the species is vulnerable to intense hunting pressures. While these iguanas have long been subjected to small-scale harvesting for food by local residents, initial research revealed that large numbers (as many as 200 individuals at a time) were being caught and sold to foreigners for the illegal pet trade. Armed with this information, as well as data on the small numbers and limited distribution of the species, representatives from Zootropic and the IUCN Iguana Specialist Group, of which the IRCF is a member, submitted a successful application to have *C. palearis* and the three other members of its clade (*C. melanosterna*, *C. bakeri*, and *C. oedirhina*) listed under CITES Appendix II.

THOMAS SCHREI

Guatemalan Spiny-tailed Iguana (*Ctenosaura palearis*) basking in the Heloderma Natural Reserve.

Increasing Awareness on Statia

Conservation awareness and education come in many forms, and sometimes it's crucial to deliver the message to the right people. For the Caribbean island of St. Eustatius ("Statia"), the IRCF designed and sponsored the installation of 20 signs notifying residents of the protected status of the Lesser Antillean Iguana (*Iguana delicatissima*). The staff of the St. Eustatius National Parks Foundation (STENAPA) reports that residents will now phone to report the presence of iguanas encroaching on their yards. In the past, these animals would have likely been killed and eaten, whereas now they can be relocated to safer areas.

NICOLE ESTEBAN

IRCF members helped support a web-based campaign to raise funds for awareness signs on behalf of the Lesser Antillean Iguana (*Iguana delicatissima*) on the island of St. Eustatius. Contributors are acknowledged at the bottom of the sign.

Gharial (*Gavialis gangeticus*)

Touted for decades as the most successful conservation story in India, the Gharial (*Gavialis gangeticus*) conservation program faltered, with only about 200 reproducing Gharials remaining in the wild. Formerly found in almost every river system in the northern Indian subcontinent, these large crocodilians are found today in only a few protected areas separated by hundreds of kilometers. Although the initial recovery initiative included both captive breeding and release programs in conjunction with the establishment of several game reserves, the plan failed to educate local farmers and fishermen. Instead, local people perceived the animals as competitors to their livelihood. Poaching has been and continues to be a major threat, especially in the National Chambal River Sanctuary (NCR), which had been a stronghold of the species for several decades.

In a revitalized conservation effort, the IRCF is now working to promote the Gharial Conservation Alliance as it resumes the work of the Gharial rehabilitation program and protection of critical riverine habitats. The current plan, however, calls for the educational efforts necessary to persuade local villagers to desist from their destructive behaviors; socio-economic work is being undertaken with the eventual aim of formulating plans for Gharial-friendly livelihood options for riverside communities within the sanctuary. Radio telemetry studies are contributing to a more scientific management plan and *in situ* as well as *ex situ* breeding programs, the latter at the San Diego Zoo, will, hopefully, give this unique species a fighting chance for survival.

JOHN BINNS

The once widely distributed Gharial (*Gavialis gangeticus*) is now limited to isolated populations in a small number of sanctuaries.

OLIVIER BORN

A young Gharial (*Gavialis gangeticus*) basks in the late afternoon sun.

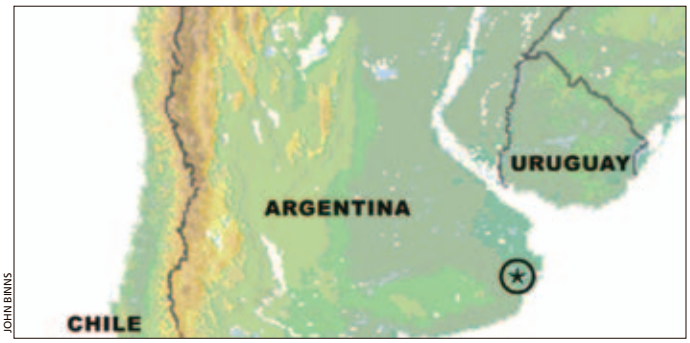
OLIVIER BORN

A group of Gharials basking on a sandbar near the National Chambal River Sanctuary. The Gharial Conservation Alliance, its members, and partner organizations are conducting research to better understand Gharials and their needs in order to develop and carry out efficient conservation strategies.

Argentine Sand Dune Lizard
(*Liolaemus multimaculatus*)

The coastal areas of Buenos Aires Province in Argentina support a diverse natural environment that includes sand beaches, cliffs, extensive sand dune fields, and lagoons. They are home to an endemic biota that has evolved in this unique environment. Unfortunately, due to uncontrolled human expansion into this region, many of these species are threatened — none more so than the Sand Dune Lizards (*Liolaemus multimaculatus*), that possess the ability to "swim" in the loose sands and coloration that is a perfect match to the local landscape. This highly specialized reptile is unable to successfully colonize other areas. If not protected, it will disappear completely from the face of the earth.

With funding support from the IRCF, the Sand Dune Lizard Study and Conservation Project has been performing critical research that will support establishment of a Coastal Dunes Reserve by the provincial government. Protected habitat is crucial to the continued survival of the remarkable Sand Dune Lizard.



JOHN BINNS

The location of the Sand Dune Lizard study and conservation project.

FEDERICO KACOLIRIS

A project researcher collects morphometric data on the Sand Dune Lizard (*Liolaemus multimaculatus*).

FEDERICO KACOLIRIS

The color pattern of the Argentine Sand Dune Lizard (*Liolaemus multimaculatus*) blends perfectly with its habitat.

Arboreal Alligator Lizards (*Abronia* spp.)

Arboreal Alligator Lizards of the genus *Abronia* are among the most endangered species of lizards in the world. In Guatemala, the genus comprises ten species, eight of them endemic; until recently, two species (*Abronia campbelli* and *A. frosti*) were thought to be extinct. Project Abronia was initiated by the Guatemalan NGO Zootropic in late 2009, with support from Zoo Atlanta, with the objective of protecting these cloud-forest-dwelling reptiles and their habitat.

The conservation plan for these secretive lizards involves basic research, workshops and environmental talks held in the areas where the various species are located, and *in situ* as well as *ex situ* breeding programs. Since habitat destruction is the primary threat to *Abronia* species, habitat protection, restoration, and reforestation are essential. The IRCF has been able to contribute critical equipment for telemetry studies and hopes to assist with other aspects of the project as funding is acquired.

THOMAS SCHREI

Campbell's Alligator Lizard (*Abronia campbelli*).

ZOOTROPIC

Environmental education has always been a component of Zootropic's conservation strategy. Groups of students, such as these, are taken on field trips to see *Abronia* in the wild in order to encourage respect for wildlife and for nature itself.

LESTER MELENDEZ

Abronia fimbriata lacks an English common name.

San Salvador Rock Iguana
(*Cyclura rileyi rileyi*)

The IRCF is currently producing awareness signage in English and French for the San Salvador Rock Iguana (*Cyclura rileyi rileyi*) in concert with the Gerace Research Centre, the College of the Bahamas, and Living Jewels Foundation to be posted on Green Cay, San Salvador, Bahamas. This species is listed as Critically Endangered, with an estimated population of 250. Green Cay is a small cay, approximately 575 m long by 70 m wide.

GOOGLE EARTH©

An aerial view of Green Cay, San Salvador. The inland darker and green areas are iguana habitat; grayish area to the shore is karst.

Right: An awareness sign measuring 46 x 69 cm. These signs are in full color, made with high-tech laminates, impervious to UV, and nearly indestructible, making them a good investment for isolated locations.

JOHN BINNS

A San Salvador Rock Iguana (*Cyclura rileyi rileyi)* on Green Cay. Pattern and coloration of the Green Cay iguanas vary considerably.

JOHN BINNS

Sister Isles Rock Iguanas (*Cyclura nubila caymanensis*) are found only on Little Cayman and Cayman Brac, Cayman Islands.

Sister Isles Rock Iguana
(*Cyclura nubila caymanensis*)

The IRCF recently initiated a program with the National Trust for the Cayman Islands to receive contributions for the purchase of critical nesting habitat for the Sister Isles Rock Iguana (*Cyclura nubila caymanensis*) on Little Cayman. In August 2011 on Little Cayman, the IRCF participated in the three-day Sister Isles Rock Iguana Species Management Plan (SMP) planning meeting facilitated by Fred Burton. Also represented were the National Trust for the Cayman Islands, the Cayman Islands Department of Environment, the Cayman Islands Department of Tourism, the Royal Cayman Islands Police Service, the Central Caribbean Marine Institute, the Blue Iguana Recovery Program, local representatives from Grand Cayman, Little Cayman, and Cayman Brac, and Matt Goetz from the Durrell Wildlife Conservation Trust, U.K. The IRCF committed funding to support the population assessment on Cayman Brac, where the rapid decline in the number of Sister Isles Rock Iguanas necessitated development of the conservation plan. A three-year SMP was produced at the meeting, and a draft of the plan is currently circulating for review. As soon as the plan has been finalized, a press release will be published. The IRCF is seeking funds to further support this effort.

"Thanks to contributions from members and the ongoing support of sponsors such as Exo Terra and the Rob Dorson Trust Fund, our strength and ability to help save species, such as the Guatemalan Beaded Lizard, Ricord's Iguana, and the Sister Isles Rock Iguana continues to grows," says John Binns. Perhaps you too can become part of the solution, helping to bring amazing reptilian species back from the brink of extinction. To learn more about the IRCF and help with its conservation work by making a contribution toward its mission, please visit our website at www.ircf.org.

Acknowledgments

The IRCF is grateful and thanks Exo Terra for its continued sponsorship, providing funds that help make our conservation efforts possible; the Rob Dorson Trust for generous contributions in memory of Rob Dorson, whose passion to help save the Blue Iguana and other endangered species continues through his Trust; the Maine Community Foundation for its generosity; Jeff Barringer for the years of help Kingsnake.com has provided promoting the IRCF on its website, and assistance at shows and conventions. We thank Bob and Sherry Ashley (NARBC/Eco Publishing) for providing space for the IRCF booth at their shows and help producing t-shirts for our supported programs; CaribSea, Inc. for their support and generous contributions; Jill Jollay for her generous donations; Sue Solomon for her contributions over the years; the Australian Herpetological Society for promoting the IRCF; Joel Friesch for his artwork contributions and efforts in the field, and Desiree Wong for her years of unwavering support and efforts. The author expresses her heartfelt appreciation to long-term colleagues and fellow *Reptiles & Amphibians* editorial staff members: Executive Editor Robert Powell, Art Director Mike Ripca, and Graphics and Photo Editor John Binns. Thanks for all the years of hard work and good humor! Thanks also to Michael Kern who produced a very early draft of this article.

KRISTINA CARPENTER

Female Timber Rattlesnake (*Crotalus horridus*) (female-515 in this study) just after emergence from hibernation.

Associative Behavior and Affinity for Anthropogenic Habitats in Two Relocated Timber Rattlesnakes

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The Timber Rattlesnake (*Crotalus horridus*) is considered to be a Species In Need of Conservation (SINC) in Kansas (Brown 1993), which affords the animals and their habitat minimal protection where they occur. Populations of this species often exist near human population centers and have perhaps the most interaction with humans among species of *Crotalus* (Walker et al. 2009). In eastern Kansas, which represents the western extent of the species' geographic range (Clark et al. 2007), human populations frequently encroach on aggregation sites (hibernacula and rookeries) of these animals and often overlap with their foraging and breeding routes during the snakes' active season (Fitch 1999, Pisani and Fitch 2006, Fitch and Pisani 2006, Edwards and Spiering 2005). In some western suburbs of Kansas City, populations of *C. horridus* utilize recently developed areas as both transient habitat (*sensu* Brown 1993) and summer range (Walker et al. 2009).

Walker et al. (2009) described movements over a 2-year period of telemetered Timber Rattlesnakes studied as part of a den-relocation effort. In February 2007, the approximately 25-year-old den on the outskirts of Lenexa (Kansas), composed of road rubble capped with ~1 m of dirt fill, was threatened with imminent destruction to permit the development of a large retail center. That study had two major goals: (1) Save this population of snakes, and (2) test a new model of conservation by relocation. Previous studies on smaller numbers of snakes under different relocation protocols had indicated that relocation generally was not a viable conservation method.

A change in the development plan spared the original den site, which remains part of a Lenexa city park. Not all Timber Rattlesnakes utilizing that den had been captured during the original relocation effort, and periodically some snakes caused public alarm by utilizing habitat around homes. On 22

Fig. 1. Male and female Timber Rattlesnakes (*Crotalus horridus*) entangled in landscaping fabric, July 2009 at a private residence in Lenexa, Kansas. These snakes (transmitter frequencies 105, 515, respectively) were subsequently relocated and their movements tracked by radiotelemetry. This photograph was taken by the homeowner.

Table 1. Four Timber Rattlesnakes (*Crotalus horridus*) relocated and discussed in this paper.

Frequency	Sex	Initial Mass (g)	SVL (cm)	Tail Length (cm)	Release Date	Mortality
373	♀ (gravid)	435	82.2	5.5	4 May 2009	Yes*
482	♀ (gravid)	543	85.3	5.5	4 May 2009	No
515	♀ (gravid)	825	99.0	7.0	16 July 2009	No
105	♂	960	97.0	8.7	16 July 2009	No

* Cause unknown.

April 2009, two female Timber Rattlesnakes were captured separately after emergence from the den, equipped with surgically implanted transmitters (radio frequencies 373 and 482) (Reinert and Cundall 1982, Reinert 1992, Hardy and Greene 2000), relocated to the same site as the snakes relocated by Walker et al. (2009), and subsequently tracked. On 6 July, two additional *C. horridus* (a male and a female) were captured together in a homeowner's yard, ~1.2 km from the Lenexa den site, tangled together in landscaping fabric. They were disentangled, implanted with transmitters (radio frequencies 105 and 515, respectively; Fig. 1; Table 1), relocated to the release site of Walker et al. 2009, and tracked. All three females contained enlarged follicles, with four, seven, and eight follicles, respectively. Like other snakes monitored by Walker et al (2009), the two 22-April snakes dispersed in a pattern that reflected initial dispersal and habitat use of snakes released during the main study (Walker et al. 2009; Fig. 2).

The two 6-July snakes, however, exhibited behavior that we perceive as peculiar for the species (Fig. 2). Rather than dispersing from their release site and each other, both stayed within ~300 m of the release site (the relocation-hibernaculum) for the remainder of the season (2½ months), with the exception of a short foray by the male to a site ~825 m straight line distance away for 2½ weeks (29 August through mid-September; Fig. 3). He subsequently returned to the pair's release site near the den and was found next to the female on 19 September. During their time in the prairie near the den, the two often were located together or near one another.

The mating system of *C. horridus* has been described as prolonged mate-search polygyny (Brown 1995), a system in which males out-compete one another in their efforts to find, court, and copulate with spatially dispersed females during a prolonged, late-summer mating season (Duvall et al.

Fig. 2. Aerial view of the release site (¶) and associated habitats (3,648 ft = 1,112 m). Each snake's periodic location (per telemetry) and habitat use (2009 season) is indicated by a different color.

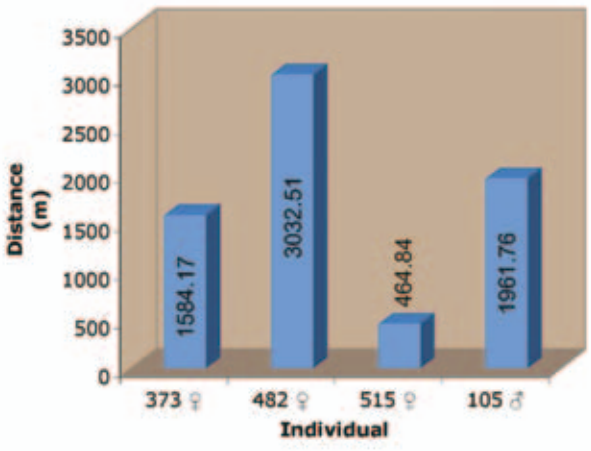

Fig. 3. Maximum dispersal distance (m) traveled by each telemetered individual during the 2009 active season.

1992). The courtship period itself may go on for weeks, and males have been observed accompanying females for up to 15 consecutive days (McGowan and Madison 2008). However, males typically end this courtship period once they have copulated, are displaced by another male, or lose interest in the female (McGowan and Madison 2008). The male in this study was paired with the female upon capture (6 July) and through the active season until both ingressed on 27 September, for a total of six weeks of pairing.

In 2010, following successful hibernation and egress from the relocation-site hibernaculum, the pair diverged. Once separated, both snakes independently exhibited an affinity for anthropogenic structures. The female remained in the yard of a nearby homeowner, and was found beneath the porch of the home multiple times throughout the season; we moved the animal ~100 m in response to homeowner requests, but the snake soon returned. She eventually had to be re-relocated to another population 40 km west in order to placate the homeowner and assure the safety of the snake. The male spent the majority of the season on the grounds of a nearby public facility, then in a different homeowner's yard, and finally in the vicinity of maintenance sheds on private property. He ultimately ingressed at an extensive anthropogenic rock-rubble pile just behind one of the maintenance buildings rather than returning to the relocation-hibernaculum. No other rattlesnakes have been observed or reported from this rubble pile.

This male and female were found ~1.2 km from the individuals collected at the original den site. They might have been part of a different original-den population; not all dens in the Lenexa outskirts have been mapped, and several potential locations exist. This could explain much of their associative behavior, as den mates belong to the same social system, are likely to be more closely related and "familiar" to one another than they are to individuals from another den, and are thought to exhibit kin recognition behavior (Clark 2004). Moreover, the area of the relocation site in which these two jointly spent the first study season (2009) contained abundant rodent trails (Walker, unpubl. data), so prey was likely abundant, making extensive foraging unnecessary. Similarly, prey was plentiful near the manmade structures where each of the two snakes spent the 2010 season (Walker, pers. obs). Specifically, the porch under which the female settled was within a few meters of a bird feeder, and feather rachises were found in snake scat beneath the porch. During one outing we observed a large Copperhead (*Agkistrodon contortrix*) in the same flowerbed within a meter of the female *C. horridus*.

In September 2007, GRP accompanied W.S. Brown to an island in Lake George, New York, on which a *C. horridus* den was located. Two people resident on the island often observed rattlesnakes in their yard, and when GRP asked where, they unhesitatingly replied "under the bird feeders." They had observed that seed dislodged from the several feeders by birds attracted abundant resident chipmunks, and these — perhaps with an occasional bird

— were a rich food resource for the rattlesnakes. Sajdak and Bartz (2004) reported predation by *C. horridus* on a Yellow-bellied Sapsucker (*Sphyrapicus varius*) in a residential yard. Brown (1993) cited observations that additionally indicate the adaptability of *C. horridus* to human presence and activity, although this can frequently result in mortality for the snakes.

Kapfer et al. (2010) indicated the importance of the ratio of suitable to unsuitable habitat in assessing the home-range size of a large snake species. An individual's home range is determined by the area the animal must traverse to successfully meet its energetic needs and encounter suitable potential mates. Presumably, if any individual *C. horridus* — a species that employs a "sit and wait" foraging strategy — could meet its foraging needs within a very small tract, it would have incentive to remain there, especially if it was a female and not driven by mate-seeking behavior. Beaupre (2008) observed behavioral differences of *C. horridus* in prey-rich and prey-poor natural conditions. Additionally, *C. horridus* is potentially long-lived (W.S. Brown, pers. comm.; Fitch and Pisani 2002) and might be capable of rapid associative learning when stimuli have high survival value (see discussion in Abramson and Place 2008).

Taken together and applied to the foraging behavior of female-515 and male-105, these observations suggest that adult *C. horridus* might be behaviorally as well as phenotypically plastic (e.g., Jenkins et al. 2009), and that some individuals might be very tolerant of (or even show affinity for) nearby human activity (Fig. 4) and disturbance if abundant prey are associated with anthropogenic habitats (gardens, buildings, etc.). Unfortunately, this tolerance is seldom extended in reverse. Although a strong affinity for buildings is atypical of Timber Rattlesnakes generally, given their widespread geographic overlap with humans (Brown 1993, Walker et al. 2009), their cryptic and generally secretive nature (Brown 1993, Furman 2007), and the copious numbers of potential prey attracted to various anthropogenic structures, that more snakes from the relocation-hibernaculum did not emulate these two animals and forage similarly near anthropogenic structures is perhaps surprising.

DYLAN LEHRBAUM

Fig. 4. Some Timber Rattlesnakes (*Crotalus horridus*) demonstrate an apparent affinity for anthropogenic habitats. This male was found beneath a construction sign.

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This feisty Green Anole is no easy lunch; he struggles to dissuade a predatory Cuban Treefrog with a tenacious bite.

A Highly Anecdotal Account of a Most Remarkable Anole

Valerie Simon

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Photographs by the author.

"You've gotta see this!" my fiancé Mark called to me one morning. He was outside, which could mean only one thing: A wildlife encounter was underway. Living in a semi-rural neighborhood in Florida, you never knew what you would see, from a mated pair of Sandhill Cranes walking down the street with their young, to Gopher Tortoises excavating burrows in the front yard.

I walked downstairs to the concrete area under our elevated house where Mark was staring at something on the ground. I looked down to see a Cuban Treefrog (*Osteopilus septentrionalis*) with the tail of a Green Anole (*Anolis carolinensis*) protruding from its gullet.

"I knew that lizard," Mark said forlornly.

"What do you mean, you recognize the lizard just by its tail?"

Should we intervene on behalf of a favorite lizard or let nature take its course?

When it seemed like we were rooting for the losing side, we walked away.

"Yeah, he was the biggest male around here. I think he was the one who watched me nail the lumber together for the floor. I swear he would follow me around."

We watched as the frog remained in a state of suspended animation for several minutes, not making much progress with its digestive activities. Finally, it started to open its mouth as though having difficulty with its prey.

"Maybe we should try to make the frog regurgitate the lizard," I said. Neither the frog nor the lizard (I could safely surmise) seemed to be having a fun time of things. Plus, as a steward of the land, I felt a responsibility to intercede in such matters.

"No, we need to let nature take its course. Besides, it might prolong the lizard's agony if he were regurgitated in a mangled state," Mark replied.

"Hmm, well, maybe you're right."

A couple minutes later the frog regurgitated the lizard on its own. The lizard turned out to be the large male after all, and its heaving sides attested to its continued survival. I ran to get my camera, and when I returned, the frog had swallowed the lizard again, tail first. This time, the lizard was fighting back by biting the frog's forelimb. As the frog tried to swallow the lizard, it simultaneously began to swallow its own forelimb. Still, the lizard's snout was gradually descending down the frog's gullet. At this point, I realized I was late for work and left soon afterwards. Mark stopped watching too. We wrote the lizard off as a goner.

The next morning, a Saturday, I was reading outside on a lounge chair when I saw a lizard in the same area as the event from the previous morning. It was a male *A. carolinensis* courting a female. I had almost returned to reading my book when I realized the lizard was missing its tail. Could it possibly be the same individual? Upon closer inspection, the lizard looked like it had been through hell. Its skin was blackened in several areas, and it had bits of what could have been digestive enzymes or half-digested prey on its dorsum. It had to be the same lizard after all! Yet despite the lizard's ordeal, it was still courting energetically … what a trooper!

Could "our" anole have survived his close encounter with the Cuban Treefrog?

Gordon became so acclimated to our presence that he would accept insects from our hands.

Over the next several weeks, the lizard, whom we named Gordon, made a complete recovery. His tail regenerated, and he became the fury of the 'hood, fighting both conspecific males and Cuban Brown Anoles (*A. sagrei*) to almost certain defeat. Perhaps unwisely, we also starting feeding him insects to the point that he would jump on our legs when he was hungry. None of the other lizards in our yard tolerated humans to this extent.

He eventually mated, and I observed the pair settling down on our landscaping plant, a Staghorn Fern, one evening, with what may have been their offspring on a lower leaf.

Gordon lived for several years until he went missing last year. Perhaps a crow that had started spending time close to the house brought about his demise, or possibly a kid from the neighborhood walking up the stairs around this time may have stepped on him, since Gordon would rarely run very far out of the way. Regardless, it was an unhappy event.

It might sound corny to say that a lizard can be inspirational, but Gordon was a testimony to the importance of tenacity — and bite force!

Gordon and his mate lounge in a Staghorn Fern with what might have been their offspring lurking beneath a lower leaf.

COMMENTARY

A Point of View: In Praise of the Zoo[1]

Alain de Botton

The zoo is not just for children,
exotic animals can help grown-ups get some perspective on their lives.

RON SANFORD

Moose (*Alces alces*) are full of a native kind of dignity and stoicism.

Moose don't loom large in the national imagination. There are only around 100 of them on these islands, but they're a fascinating and noble kind of creature. Ugly from one point of view, rather as camels are, but full of a native kind of dignity and stoicism.

I'm mentioning moose because earlier this summer, rather unreported by the media, a baby moose was born in Whipsnade Zoo. It got called Chocolate by the Zoological Society of London, and — according to an e-mail that was sent out to all members of the zoo — it's doing very well. It's being looked after by its concerned mother Minni and its protective dad Melka. Both can now be seen in a special exhibit called Wild Wild Whipsnade. If you fancy a trip, as the same e-mail went on to explain, you might want to take in Sapo the pygmy hippo, who's recently taken his first dip in an outdoor pool.

Displacing Egos

I know David Attenborough has been doing a heroic job — not least in this slot over the last few months — trying to change this state of affairs, but it's fair to say that before I had children I simply never thought of wild animals. The odd TV documentary excepted, they just didn't figure on my radar. My extracurricular activity tended to be culturally based, and animals — as we know — don't loom large in culture. The elegant question is always whether one has caught the new show at Tate Modern or play at the

ERIC ISSELÉE

The elegant question is whether one has caught the newest exhibit or play, never what one makes of the new Burmese Python (*Python bivittatus*) at the zoo.

[1] Adapted from a commentary in the BBC News Magazine (8 July 2011; <www.bbc.co.uk/news/magazine-14078657>).

BRANDON ALMS

Thanks to children, adults can learn to live in a world of exotic animals, and to spend time thinking about Tapirs, Meerkats, and Green and Black Poison Dart Frogs (*Dendrobates auratus*).

ERIC ISSELÉE

Interest in animals often is framed in childlike terms and zoos are bathed in children's language and iconography. Animals invariably are given names designed to appeal to kids, like Moomoo the tiger and Speccie the Ring-tailed Lemur (*Lemur catta*).

Donmar Warehouse, never what one makes of the new Bactrian Camel or Burmese Python at London Zoo.

Yet thanks to my two young sons, I now live immersed in the world of exotic animals. We spend our time thinking about Malayan Tapirs and Peruvian Chinchillas, Meerkats from the Kalahari Desert, and green and black poison frogs from Costa Rica. Some of every weekend is spent impersonating these animals on the carpet, the rest on discussing their habits, favorite foods, and the gathering odds of encroachments on their habitats. But this really seems just a way of circling around something more unnam-

ERIC ISSELÉE

CAROLINA GARCIA ARANDA

Adults, much more so than children, are in serious need of a few minutes of reflection on the lives of Humboldt Penguins (*Spheniscus humboldti*) and Egyptian Tortoises (*Testudo kleinmanni*).

able and potent — a fundamental wonder at the sheer existence of creatures so weird and beautiful, so unlike us and yet strangely evocative of parts of us. Alive on our planet at the same time as we are but unreachable by our normal means. Our unknown contemporaries in a galaxy otherwise made up of gas and rock, with not a single other heartbeat within it.

I'm deeply grateful to my children for reintroducing me to wild animals, and yet — with no disloyalty to them — also a little frustrated at the way that zoos (and wider society of course) tend to frame an interest in these animals in such resolutely childlike terms. The world of zoos is bathed in children's language and iconography. The animals are invariably given names designed to appeal to kids, like Moomoo the tiger, Sparkly the Oriental Small-clawed Otter, and Speccie the Ring-tailed Lemur.

The food in the cafes is geared to young appetites and the general impression is that unless you're on a trip with someone under 14 and are eating an ice cream as well, there might be something a little wrong with you for wandering around zoo exhibits.

Animal Gods

I understand why zoos do this — kids are a captive market. The pressures on them financially are extremely grave and hippos hold the attention of five-year-olds in a way that the paintings of Ingres or Rothko just

don't, despite the truly heroic efforts of the kids' outreach programs of the National Gallery and the Tate. Yet something does seem to be lost in this focus on children, which is the enormous benefit that the average adult could and should be deriving from encounters with these animals. The typical urban stressed and harried adult is in serious need of a few minutes of reflection upon the life of a Humboldt Penguin or Egyptian Tortoise, more so than his or her child.

At heart, these animals offer us many of the same lessons as religions but without any of the doctrines or supernatural claims. They're walking, munching, biting, bellowing reminders not to take ourselves as the centres of the universe. While wandering around their enclosures they deliver heart-warming covert sermons in the wisdom of displacing our own egos. The metaphysical importance of zoos is anchored in the way that we tend to loom so absurdly large in our own imaginations. We overstate every aspect of ourselves: how long we are on the planet for, how much it matters what we achieve, how rare and unfair are our professional failures, how rife with misunderstandings are our relationships, how deep are our sorrows. Left to their own devices, our minds are hopelessly egoistic.

Getting Perspective

That's where the animals come in. They are what Emile Durkheim, that great theorist of religions, described as representatives of "the Other", something non-human which puts us in our place, stills our anxieties, reminds us we're not the only show in town, and generally urges us to make a little more room in our imaginations for things that aren't related to our own selves. Typically for the last few millennia in the West, "the Other" has meant God. A force far larger, older, and more mysterious than we are, to which we should — at selected moments in the week — acknowledge, defer, and give way.

We tend not to bother with a religious "Other" quite so much in swiftly secularizing Britain, and that's perhaps one reason why we're a little more fragile in our psyches as well. We need regular encounters with otherness so as not to loom dangerously large to ourselves. That's why people get so much out of nature or from the stars or the great deserts. To be made to feel small is, to be sure, a painful daily reality of the human playground. But to be made to feel small by something beautiful, noble, accomplished, or just weird like the greater one-horned Asian rhino is to have wisdom presented to us along with a measure of delight.

There are zoo animals like the Arabian Oryx that can induce us to surrender our egoism without in any way humiliating us. Looking at them, we can set aside our ordinary concerns and take on board — in a way we never dare to do when we are under direct fire from other humans — our own relativity. We can survey ourselves as if from a distance, no longer offended by things, perhaps newly indifferent to our eventual fate, generous towards the universe, and open-minded about its course.

Religions outside the Abrahamic tradition have always understood how much we have to learn from animals, how much the attitudes of animals are those we should emulate in ourselves, and how calming it can be to place something non-human at the centre of your culture. Buddhists in Thailand will honor the white elephant for its courage, strength, and calm nature, the very qualities they believe that the Buddha wished to see us cultivate in ourselves. Likewise, the ancient Egyptians connected their gods to animals in ways that urged humans to draw from the varied virtues of the animal kingdom.

When zoos try to explain to us what they're up to, they often fall back on describing an educational mission. They announce that they are there to teach us where animals come from, how much they eat, and how many young they typically have. This is all true and very good, but there's maybe another no less vital mission. We should learn about animals not just for their sake, but — as religions have known — also for our own.

Among other things, the point of zoos should be to give us perspective on ourselves, to push us towards an awareness — always under threat in daily life — of the diversity, mystery, scale, age, and complexity of the earth. But unlike zoos at present, perhaps we should not have to think that the point of the exercise is to give us a grounding in a scientific education. It should not in the end matter very much whether visitors have ever really mastered the differences between, say, the African and Indian elephant, the detailed explanations of which are often painfully labored over by zoo curators and yet so likely to have been forgotten by most of their audience by the time they reach the car park. We should allow ourselves to handle zoology in the interests of stirring awe rather than in the name of promoting knowledge, biology leant upon for its therapeutic, perspective-giving capacity rather than its factual value.

Even if you have no children, don't like ice creams, and are deeply allergic to hearing animals called things like Shamoo and Bibi, it may still be worth making an appointment with a gecko or Sri Lankan Sloth Bear in a zoo.

THOMAS DAM

Even if you have no children, you still might benefit from an appointment with a Leopard Gecko (*Eublepharis macularius*).

Critically endangered Lemur Tree Frogs (*Hylomantis lemur*), which are native to Central America, were successfully bred at the The Wildlife Conservation Society's Bronx Zoo.

HUSBANDRY

Lemur Tree Frog (*Hylomantis lemur*) Egg and Tadpole Development at the Bronx Zoo

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Photographs by the author.

Listed by the IUCN as critically endangered, Lemur Tree Frogs (*Hylomantis lemur*) occur predominantly in pre-montane and montane primary forests of Costa Rica and Panama (Stuart et al. 2008). Commonly found in captive collections, this nocturnal species has been bred at several institutions. In the wild, reproduction generally occurs during the rainy months of April through June (Savage 1992). Amplectant pairs deposit 15–30 eggs on the surface of leaves overhanging bodies of water and may produce multiple clutches in one night (Savage 1992, Stuart et al. 2008). As early as seven days after fertilization the eggs begin to hatch and drop into the water below (Stuart et al. 2008). Metamorphosis begins approximately 65–90 days after hatching (Stuart et al. 2008).

The Wildlife Conservation Society's Bronx Zoo maintains five adult *H. lemur* in an off-exhibit quarantine room at the World of Reptiles. On 8 August 2010, 3.2 *H. lemur* were set up in a 45.7 x 45.7 x 45.7 cm Zoo Med Naturalistic Terrarium (Zoo Med Laboratories, San Luis Obispo, California) furnished with plants, cork bark, and PVC pipes. The tank was plumbed with a bulkhead and outfitted with an automated misting system. Full-spectrum fluorescent fixtures provided ambient lighting and a single basking spot was provided with a 50-watt Eiko Solux light bulb (Eiko Ltd., Shawnee, Kansas).

In order to elicit breeding, the misting of the tank was increased from five minutes an hour to approximately 45 minutes an hour. Additionally,

Amplexus was first observed 16 days after misting was increased.

Day 1: Eggs discovered on 26 March 2011 (Gosner Stage 3).

Day 3 (Gosner Stages 15 and 18).

Day 5 (Gosner Stage 18).

Day 6 (Gosner Stage 20).

Day 9: Eggs hatched (Gosner Stages 22–24).

Day 14: Six days after hatching (Gosner Stage 25).

Day 59: Legs are visible (Gosner Stages 33–36).

Immediately prior to metamorphosis (Gosner Stage 42).

Days 75–122: Metamorphs (Gosner Stages 42–46).

a bulkhead was used to maintain 1.3 cm of water in the bottom of the tank and an extra basking spot was provided. On 22 September 2010, after a little over a month with no signs of reproduction, rain was reduced to five minutes an hour, just enough to keep the tank moist. A little over two months later, another seasonal rain cycle was initiated. Amplexus was first observed 16 days after misting was increased and continued sporadically throughout the remainder of the month. A small clutch of eggs was discovered 49 days into the rainy cycle, but unfortunately this clutch never developed. Rain was continued until 28 January 2011, 16 days after the first clutch was laid and the day after a snowstorm, when two small clutches of eggs were discovered in the enclosure. Eggs hatched eight days after they were laid. Metamorphs (or froglets) emerged 72–80 days after oviposition, immediately following the emergence of forelimbs.

On 22 March 2011, following two days of rainy weather, one of the females was sitting in an alert posture and appeared gravid. Increased misting was started that night and three large clutches of eggs were discovered in the enclosure four days later. Eggs began hatching in nine days and developed into metamorphs anywhere between 75 and 112 days after hatching. The chronological depiction of the developmental process of *Hylomantis lemur* at the Bronx Zoo uses Gosner's (1960) table for staging the embryos.

Acknowledgments

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INTRODUCED SPECIES

Green Anoles (*Anolis carolinensis*) on Canouan, St. Vincent and the Grenadines

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In June 2011, Quarantine Officer Basil Nash found four lizards in a container arriving on Canouan in the Grenadines. Subsequent to the discovery, the container, with an origin in Florida, USA, was closed and fumigated and all lizards were killed. The lizards were tentatively identified from photographs as *Anolis carolinensis* by Robert Powell, although he could not categorically rule out the possibility that they could be *A. porcatus*, a Cuban anole established in southern Florida. A photographic voucher is deposited in the Milwaukee Public Museum (MPM Herpetology P761).

AMOS GLASGOW

This adult male *Anolis carolinensis* was one of four individuals found in a container originating in Florida after its arrival on Canouan, St. Vincent and the Grenadines.

Anolis carolinensis, which is native to the southeastern United States, has been documented from Anguilla, Grand Cayman, and the Bahamas in the West Indies (Powell et al. 2011); the species also is widely established on a number of Pacific islands (Kraus 2009). Although the latter usually are attributed to the commercial live animal trade, the West Indian animals, like these on Canouan, almost certainly arrived as "hitch-hikers" in shipments of plants.

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A Non-native Skink on Grand Bahama

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At 1032 h on 23 July 2011 at Lucayan National Park on Grand Bahama, Commonwealth of the Bahamas, I observed and photographed a non-native skink in leaf litter along a walking path in low coastal coppice forest near the beach. Robert Powell, Kenneth L. Krysko, and Joseph T. Collins identified the skink as *Plestiodon* sp. from the photograph. I was unable to catch the lizard, which precluded an examination of scales necessary for identification to species. The photographic voucher (Fig. 1) is deposited in the Milwaukee Public Museum (MPM Herpetology P757).

The presence of skinks in Lucayan National Park has been known since 2008, when Eric Carey, Executive Director of the Bahamas National Trust, sent photographs of a skink (Fig. 2) to Sandra Buckner. Unable to identify the lizard to species, it was not recorded nor included in Knapp et

SCOTT JOHNSON

Fig. 1. This adult male *Plestiodon* sp. (top) formally documents the presence of this genus in the West Indies.

ERIC CAREY

Fig. 2. Photograph of an unidentified skink taken at the Lucayan National Park, Grand Bahama, on 14 August 2008.

al. (2011). The 2008 photograph, which illustrates a juvenile, and additional anecdotal reports of skinks in the park and nearby areas that have accrued since 2008 speak to the likelihood of a firmly established population.

Although abundant and widely distributed in the southeastern United States, no previous records of skinks in the genus *Plestiodon* exist for the Bahamas or the entire West Indies (Powell et al. 2011). Although occasionally found in the commercial live animal trade, the most likely means of introduction is as a "hitch-hiker" in shipments of plants. Although found in a national park, nearby areas on Grand Bahama feature landscaped gardens with many imported exotic plants.

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The Marbled Treefrog (*Dendropsophus marmoratus* [Laurenti 1768]) (Hylidae), Another Introduced Amphibian Species in Florida

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The Marbled Treefrog (*Dendropsophus marmoratus* [Laurenti 1768]) is indigenous to the rainforests of Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname, and Venezuela (Duellman 1978, Rodríguez and Duellman 1994).

On 10 January 2011 at 2342 h, MRR and KPW collected an adult *D. marmoratus* (UF 164381) on a wall about 150 cm above the ground just outside the property of an animal importer's facility at 6450 Stirling Road, Hollywood, Broward County, Florida (26.04591°N, –80.21976°W). This individual likely was released or had escaped from an enclosure at the facility. This animal importer is the most likely source for the introduction of at least 32 (23.3%) of the 137 confirmed herpetofaunal taxa introduced in Florida from 1995–2010 (Krysko et al. 2011). These taxa either have not been found elsewhere in Florida or have not established populations in areas leading to the facility. Furthermore, at least most and possibly all have been listed in the inventory of this dealer, although incorrect scientific and/or common names have been used in some instances. This specimen represents the first known voucher for this species of frog, the 33rd introduced species from this animal importer, and the 138th confirmed introduced herpetofaunal species in Florida.

Acknowledgments

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MICHAEL R. ROCHFORD

MICHAEL R. ROCHFORD

Dorsal (left) and ventral views (right) of an adult Marbled Treefrog, *Dendropsophus marmoratus* (UF 164381), from Hollywood, Broward County, Florida.

CONSERVATION RESEARCH REPORTS

Wind Energy Production and Desert Tortoises

LOVICH ET AL. (2011. *Herpetological Conservation and Biology* 6:161–174) studied an Agassiz's Desert Tortoise (*Gopherus agassizii*) population at a large wind energy generation facility near Palm Springs, California over six field seasons from 1997 to 2010. The authors compared growth and demographic parameters to populations living in less disturbed areas, as well as populations of the closely-related and newly-described Morafka's Desert Tortoise (*G. morafkai*) elsewhere in the Sonoran Desert of Arizona. They marked 69 individuals of all size classes and estimated a population size of 96 tortoises, or about 15.4/km^2. Growth rates for males were lower than reported elsewhere, although maximum body size was larger. The smallest female with shelled eggs was 221 mm and males mature at over 200 mm. Mean male size was greater than that of females. The adult sex ratio was not significantly different from unity. Size frequency histograms were similar over time and when compared to most, but not all, *G. morafkai* populations in the Sonoran Desert. For a cohort of adult females, mortality was estimated at 8.4% annually due, in part, to site operations. This value was low in comparison to many other populations during the same time period. Other than possible differences in growth rate of males and the high survivorship of females, few differences are evident between this population and those in more natural areas. The high productivity of food plants at the site and its limited public access may contribute to the overall stability of the population. However, the effects of utility-scale renewable energy development on tortoises in other, less productive areas are unknown. Additional research (especially controlled and replicated before and after studies) is urgently needed to address this deficiency because of forecasted expansion of utility-scale renewable energy development in the future.

JEFFREY E. LOVICH

An Agassiz's Desert Tortoise (*Gopherus agassizii*) at a large wind energy generation facility near Palm Springs, California.

Risk Assessment of Exotic Reptiles in Southern Florida

The recent explosion in the number of exotic reptiles in southern Florida requires effective management strategies. The objective of this study was to use ecological correlates and quantitative modeling methods to facilitate the development of management strategies by providing the foundation for a screening procedure that will identify potentially invasive species and assess adverse impacts associated with those species. **FUJISAKI ET AL.** (2010. *Biological Invasions* 12:2585–2596) considered 17 variables and, based on model selection procedures, identified the following significant predictors of establishment success: Taxonomic order, maximum temperature match between a species' native range and Florida, animal sale price, and manageability (defined as a species' maintenance cost, aggressiveness, proneness to escape, and venomousness). Applying the models to predict establishment success of 33 reptiles that were most frequently imported through Miami and St. Petersburg ports from 2000 to 2005 and two additional reptiles of concern in Florida, the authors identified eight lizards and four snakes as potentially successful invaders. They further assessed adverse impacts associated with potential invaders, should they become established, by identifying species that are (1) dangerous to humans, (2) dangerous to the ecosystem (upper trophic-level predators), and (3) capable of spreading rapidly. Controlling exotic reptiles can be expensive and labor intensive once they are established. Information on which species are potential invaders based on screening procedures and what impacts these species might cause will be a valuable contribution to the development of proactive management strategies.

JULIUS RÜCKERT

JOHN WHITE

The Puff Adder (*Bitis arietans*, top) and the Long-tailed Grass Lizard (*Takydromus sexlineatus*) are among four species of snakes and eight species of lizards identified as potentially successful invaders in southern Florida. The Puff Adder is potentially dangerous to humans, consumes vertebrates, and thus could become an upper-level predator in the ecosystem. The Long-tailed Grass Lizard is a potentially fast-spreading species that can produce large numbers of eggs annually.

Environmental DNA Detection of Rare Vertebrates in Streams

Stream ecosystems harbor many secretive and imperiled species, and studies of vertebrates in these systems face the challenges of relatively low detection rates and high costs. Environmental DNA (eDNA) has recently been confirmed as a sensitive and efficient tool for documenting aquatic vertebrates in wetlands and in a large river and canal system. However, this tool had not been tested for detecting low-density vertebrates in fast-moving streams where shed cells may travel rapidly away from their source. To evaluate the potential utility of eDNA techniques in stream systems, **GOLDBERG ET AL.** (2011. *PLoS One* 6:1–5) designed targeted primers to amplify a short, species-specific DNA fragment for two secretive species of stream amphibians in the northwestern United States (Rocky Mountain Tailed Frogs, *Ascaphus montanus*, and Idaho Giant Salamanders,

JASON JONES

Environmental DNA (eDNA) was recently confirmed as a sensitive and efficient tool for documenting low-density aquatic vertebrates in fast-moving streams by successfully detecting Rocky Mountain Tailed Frogs (*Ascaphus montanus*; top) and Idaho Giant Salamanders (*Dicamptodon aterrimus*; bottom) in central Idaho.

Dicamptodon aterrimus). The authors tested three DNA extraction and five PCR protocols to determine whether they could detect eDNA of these species in filtered water samples from five streams with varying densities of these species in central Idaho. They successfully amplified and sequenced the targeted DNA regions for both species from stream water filter samples, detecting Idaho Giant Salamanders in all samples and Rocky Mountain Tailed Frogs in four of five streams and determining that these species are more difficult to detect using eDNA in early spring than in early fall. While the sensitivity of this method across taxa remains to be determined, the use of eDNA could revolutionize surveys for rare and invasive stream species. With this study, the utility of eDNA techniques for detecting aquatic vertebrates has been demonstrated across the majority of freshwater systems, setting the stage for an innovative transformation in approaches for aquatic research.

Snakes and Conservation Buffer Strips in an Agricultural Landscape

In regions of the United States that are predominately devoted to agricultural production, most grassland habitat remains as linear strips, including areas along roads and within conservation buffer strips. While land management agencies in the United States promote conservation buffer strips as beneficial to wildlife populations, we know little about the use of these habitats by snakes, especially in relation to multiscale factors. Our poor understanding of these relationships hinders effective design and management of these habitats to conserve biodiversity. **KNOOT AND BEST** (2011. *Herpetological Conservation and Biology* 6:191–201) evaluated the influence of buffer design, management, and surrounding landscape characteristics on snake occurrence in grassed waterways in southeastern Iowa. The authors documented snakes at nearly 80% of the grassed waterways and captured 119 individual snakes of five species; one of which, the Smooth Green Snake (*Lioclorophis vernalis*), is listed as a species of conservation concern in Iowa. They used a multiple logistic regression and an information theoretic approach to determine the most parsimonious local and landscape variable models that best explained snake species occurrence. The "local" waterway design variable, width, occurred in the best local variable models for three of the five species and was positively associated with snake presence for all three species. Landscape variable models also helped explain snake presence; individual species responded differently to the various landscape metrics. Insights gained from this study might provide opportunities for improving the conservation value of buffer strips to snakes in these fragmented landscapes.

SUZANNE L. COLLINS, CNAH

The Smooth Green Snake (*Lioclorophis vernalis*) was one of five species captured during a study that showed a positive correlation between buffer-zone width along grassed waterways in southeastern Iowa and the presence of snakes.

Ecotourism has Negative Effects on Northern Bahamian Rock Iguanas

HINES (2011. *Herpetological Conservation and Biology* 6:250–259) evaluated effects of tourist visitation and supplemental feeding on Northern Bahamian Rock Iguanas (*Cyclura cychlura*) in the Exumas, Commonwealth of the Bahamas. The study examined flight behavior and diet on islands that were visited versus those not visited by tourists. Iguanas on visited islands were less wary of human presence than those on non-visited islands. Unlike on non-visited islands, iguanas on beaches where they were fed by tourists consumed people-influenced items including trash (e.g., styrofoam, aluminum foil), non-native fruits and vegetables (e.g., grapes, tomatoes), and sand. Non-native fruits provided a higher liquid content diet than did native vegetation, which, when mixed with sand, created cement-like feces that may have medical consequences. Tourism has encouraged an increase in these iguana populations, but negative impacts, such as loss of wariness and dietary shifts as well as possible demographic consequences, also are occurring. These adverse effects might be ameliorated by changed practices, but such changes must be instituted with full participation by local stakeholders.

KIRSTEN HINES

Tourists feeding Northern Bahamian Rock Iguanas (*Cyclura cychlura*) on the landing beach at Leaf Cay in the northern Exuma Islands.

Changes in the Trade of Amphibians and Reptiles over a 10-year Period

Tapley et al. (2011. *The Herpetological Journal* 21:27–34) compared the trade in reptiles and amphibians in the United Kingdom between 1992–3 and 2004–5. In particular, the impacts of captive breeding and color and pattern morphs on price structures were examined. The number of amphibian and reptilian species in the trade more than doubled over this period, and less than a third of the species traded were common to both trading periods. More traded species were listed by CITES in 1992–3 than in 2004–5. Taking into account inflation, the study showed that the price of all groups of reptiles and amphibians recorded increased over the ten-year period, and that some snake species had done so dramatically when color and pattern morphs were considered. The price change of chelonians was probably the result of responses to changes in various trade regulations. Price increases for amphibians seemed to represent their increased popularity, coupled with the overhead costs of captive breeding on a commercial scale being transferred to the hobbyist. The increased popularity of captive-bred color and pattern morphs could alleviate pressure on wild stocks. On the other hand, as such animals are predominantly being produced outside their countries of origin, no benefits accrue to local people and trade could undermine sustainable-use programs for wild animals.

SUZANNE L. COL LINS, CNAH

Red-eared Sliders (*Trachemys scripta*) showed the greatest (754%) price increase over a 10-year period of all turtles traded in the United Kingdom.

MICHAEL A. POWELL

Despite many conflicts with human interests, non-native Green Iguanas (*Iguana iguana*) are ubiquitous in southern Florida and are not currently subjected to any systematic, organized management efforts.

Exotic Reptiles in Florida

Florida and Hawaii have the two worst invasive species problems in the U.S. Florida in particular is especially susceptible to the establishment of alien reptiles. In addition to the sheer numbers of established non-native reptilian species in the state, many of these species present novel difficulties for management, or have other characteristics making effective management extremely challenging. Moreover, initiation of management action requires more than recognition by experts that a potentially harmful species has become established. It also requires the political will along with concomitant resources and appropriate personnel to develop effective methods and apply them. **Engeman et al.** (2011. *Current Zoology* 57:599–612) reviewed the situation in Florida, including assessment of risk for establishment, and used a subset of prominent species to illustrate in more detail the array of circumstances involving invasive reptilian species in Florida, including routes of introduction, impacts, and potential and implemented management actions. These examples not only highlight the severity of the invasive reptile problems in the state, but they also show the diversity in resolve and response toward them and the factors that motivate these responses.

NATURAL HISTORY RESEARCH REPORTS

Survival, Breeding Frequency, and Migratory Orientation in Jefferson Salamanders

Accurate estimates of demographic parameters, such as survival and breeding frequency, are necessary for the conservation and management of animal populations. Additionally, life-history data are required for gaining an empirical understanding of the ecology of natural populations. **De Lisle and Grayson** (2011. *Herpetological Conservation and Biology* 6:215–227) monitored a population of Jefferson Salamanders (*Ambystoma jeffersonianum*) breeding in a permanent mountain-top pond at the southern limit of this species' geographic range in Virginia over four years. The authors used closed multistate mark-recapture models with Pollock's robust design to estimate the demographic parameters of this population. Additionally, they used point-of-capture data to compare the orientation of migrations into and out of the pond within and among years. The model selection results support consistent annual adult survival across years with higher estimates for males compared to females. Estimates of the probability of breeding in sequential years were high for both sexes during the four years of the study. Model rankings and capture probability estimates indicate that females had a higher probability of detection when entering the breeding pond, likely reflecting differences between the sexes in arrival time at the pond. Directionality was evident in some but not all annual migrations, despite indications of individual fidelity

KRISTINE GRAYSON

Our understanding of reproduction and natural history of pond-breeding amphibians benefited greatly by a study of Jefferson Salamanders (*Ambystoma jeffersonianum*) in Virginia.

in orientation across years. This study provides the first estimates of breeding probability and assessment of migratory orientation patterns for *A. jeffersonianum* and contributes to the understanding of the reproductive ecology and natural history of pond-breeding amphibians.

Habitat Use and Home Ranges of Longnose Leopard Lizards

An understanding of species' habitat requirements is needed for effective land management decisions, but for many North American reptiles, habitat use information is lacking. The Longnose Leopard Lizard (*Gambelia wislizenii*) is a predatory lizard of most North American deserts, and, although common in the interior of its range, appears to be declining at some peripheral populations. To understand habitat use and movement patterns, **SCHORR ET AL.** (2011. *Herpetological Conservation and Biology* 6:312–323) used telemetry and two habitat comparison methods to study a *G. wislizenii* population at the eastern boundary of the range. *Gambelia wislizenii* home ranges at Canyons of the Ancients National Monument, Colorado, are the largest recorded. Habitat analysis using microsite-attribute comparisons and compositional analysis documented second-order habitat preference for Big Sagebrush- or Utah Juniper-dominated landscapes. *Gambelia wislizenii* was found in areas with moderate shrub and forb cover with much bare ground, but not in areas dominated with grass cover. Incorporating management strategies that limit grass encroachment and maintain bare ground cover with moderate tree and shrub cover might help sustain populations of *G. wislizenii.*

PAUL MOREY

Home ranges of the Longnose Leopard Lizard (*Gambelia wislizenii*) at Canyons of the Ancients National Monument, Colorado, are the largest recorded. This predatory lizard of most North American deserts, here eating a Sagebrush Lizard (*Sceloporus graciosus*), was found in areas with moderate shrub and forb cover and much bare ground, but not in areas dominated with grass cover.

NEWSBRIEFS

Snakes on a Train!

A clumsy smuggler, who managed to get away, failed to contain the dozens of King Cobras and other snakes he was transporting from Ho Chi Minh City in Vietnam to Hanoi (probably to be sold illegally to restaurants). After panic broke out on the train and police were called, the snakes were collected and turned over to a sanctuary. Upscale restaurants can charge as much as the equivalent of $500 for a meal of King Cobra, beginning with the selection of the snake, having it killed at tableside, and including a serving of a snake's-blood appetizer. In one survey, 84% of Hanoi's restaurants were serving illegal wild animals of some sort, including weasel, monitor lizard, and porcupine.

OMAR ARIFF

Upscale restaurants in Vietnam can charge as much as the equivalent of $500 for a meal of King Cobra.

"News of the Weird for August 7"
Daily Herald, Provo, Utah

Giant Crocodile Captured Alive in the Philippines

Villagers and veteran hunters have captured a one-ton Saltwater Crocodile (*Crocodylus porosus*), which they plan to make the star of a planned ecotourism park in a southern Philippine town. Mayor Edwin Cox Elorde said dozens of villagers and experts ensnared the 21-foot (6.4-meter) male along a creek in Bunawan township in Agusan del Sur Province after a three-week hunt. It could be one of the largest crocodiles to be captured alive in recent years, he said, quoting local crocodile experts.

Elorde said the crocodile killed a water buffalo in an attack witnessed by villagers last month and was also suspected of having attacked a fisherman who went missing in July. He said he sought the help of experts at a crocodile farm in western Palawan province. "We were nervous, but it's our duty to deal with a threat to

Saltwater Crocodiles (*Crocodylus porosus*) are the largest extant crocodilians. A male (not the individual illustrated) measuring 6.4 m in total length was captured by residents and crocodile farm staff along a creek in Bunawan in the southern Philippines.

the villagers," Elorde told the Associated Press by telephone. "When I finally stood before it, I couldn't believe my eyes."

After initial sightings at a creek, the hunters set four traps, which the crocodile destroyed. They then used sturdier traps using steel cables, one of which finally caught the enormous reptile late Saturday. About 100 people had to pull the crocodile, which weighs about 2,370 lbs (1,075 kg), from the creek to a clearing where a crane lifted it into a truck. The crocodile was placed in a fenced cage in an area where the town plans to build an ecotourism park for species found in a vast marshland in Agusan, an impoverished region about 515 mi (830 km) southeast of Manila. "It will be the biggest star of the park," Elorde said, adding that villagers were happy that they would be able to turn the dangerous crocodile "from a threat into an asset."

Despite the catch, villagers remain wary because several crocodiles still roam the outskirts of the farming town of about 37,000 people. They have been told to avoid venturing into marshy areas alone at night.

Adapted from the Associated Press
5 September 2011

Eastern Diamondback Rattlesnakes Suffer Sharp Declines from Habitat Destruction and Human Persecution

Just days after the Lake Erie Water Snake (*Nerodia sipedon insularum*) was declared recovered and removed from the federal endangered species list, snake researcher Dr. Bruce Means and three conservation groups (the Center for Biological Diversity, Protect All Living Species, and One More Generation) asked the government to save another snake, the Eastern Diamondback Rattlesnake (*Crotalus adamanteus*), by adding it to the list of protected species.

Dr. Means and the groups submitted an extensive scientific petition to the U.S. Fish and Wildlife Service detailing the snake's natural history and decline toward extinction. The petition initiates a formal, multiyear review process under the Endangered Species Act to determine whether the Eastern Diamondback Rattlesnake warrants protection as a "threatened" species.

SUZANNE L. COLLINS, CNAH

The Lake Erie Water Snake (*Nerodia sipedon insularum*) was declared recovered and removed from the federal endangered species list earlier this year after its population grew to more than 11,000 as a result of habitat protection, public education, and protection from killing.

"We're seeking to protect the Eastern Diamondback Rattlesnake under the Endangered Species Act because it has a nearly perfect record of saving imperiled species," said Collette Adkins Giese, a conservation biologist with the Center for Biological Diversity. "The Endangered Species Act just saved the Lake Erie Water Snake — it's the surest tool we have to save the rattlesnake too."

The Lake Erie Water Snake was listed as a threatened species in 1999 with a population of just 1,500–2,000 snakes. It was delisted earlier this year after its population grew to more than 11,000 as a result of habitat protection, public education, and protection from killing. Similar recovery actions are also needed for the Eastern Diamondback Rattlesnake, which is facing the same threats that the water snake faced.

Dr. Means and colleagues first documented the decline of the Eastern Diamondback Rattlesnake in a paper published in 2000 in the scientific journal *Herpetological Natural History*. The paper concluded that the species was "declining almost all over its range" and that human exploitation was having "a severe impact on remaining populations." Dr. Means has conducted fieldwork in the southeastern United States for 40 years, including extensive research on the Eastern Diamondback Rattlesnake; he is an adjunct professor at Florida State University and is president of the Coastal Plains Institute.

"The Eastern Diamondback Rattlesnake is a wildlife icon of North America. Africa has its lion, Asia its tiger, and we can boast of this marvelous 'Don't Tread On Me' snake," said Dr. Means. "Like so many others, it's a wildlife treasure that we must not allow to go extinct. Remaining habitat for the snake must be preserved, and negative public attitudes toward these nonaggressive animals must be reversed."

The Eastern Diamondback Rattlesnake was once abundant in longleaf pine savannas across the southeastern United States, but only 2–3% of the original habitat remains. Exploitation by humans is also having a severe impact. Thousands of the rattlesnakes are killed each year for their skins and meat with no limits on annual harvests in South Carolina, Georgia, Florida, Mississippi, Alabama, and Louisiana — and in Alabama and Georgia, these snakes are targeted by "rattlesnake roundups," gruesome festivals that offer prizes to encourage hunters to collect the imperiled snakes, which are exhibited and then slaughtered.

"Sadly, the demise of the Eastern Diamondback Rattlesnake is being incentivized by rattlesnake roundups," said Jim Ries of One More Generation. "Converting these events to rattlesnake festivals where the species is celebrated for its value to the ecosystem would continue to generate revenue for local communities while preserving the species."

The Eastern Diamondback Rattlesnake poses little public safety risk. Although it is venomous, more people are killed every year by lightning strikes and bee stings. The proportion of people who are snake-bitten while engaging in outdoor activities is also very low. Those most likely to be bitten are snake handlers who either keep venomous snakes in captivity or work with them professionally. Still, malicious killings by those who perceive the snake as a threat are contributing to its decline.

SUZANNE L. COLLINS, CNAH

Only 2–3% of the original habitat of the Eastern Diamondback Rattlesnake (*Crotalus adamanteus*) remains. In addition, thousands are killed each year for their skins and meat, and in Alabama and Georgia, these snakes are targeted by "rattlesnake roundups," during which snakes are exhibited and then slaughtered.

"Survival of these snakes in large part depends on whether people continue to persecute them or instead choose to allow these amazing creatures to share the land with us," said Bill Matturro of Protect All Living Species. "As a farmer and owner of wooded land, all living things on my land — including Eastern Diamondback Rattlesnakes — are both respected and protected."

The Center for Biological Diversity recently signed a historic agreement with the U.S. Fish and Wildlife Service under which the agency agreed to make protection decisions for hundreds of species over the next several years. Although the agency is normally required to respond to a petition within one year, any decision on the Diamondback will likely be delayed as the Service works through the backlog of species needing protection and addressed in the agreement. "Securing protection for the Eastern Diamondback Rattlesnake is likely to take several years," said Adkins Giese. "We hope that steps will be taken in the interim to protect the Eastern Diamondback and prevent further population declines."

Background

The Eastern Diamondback Rattlesnake is the largest rattlesnake in the world. Adults are typically four to five feet long and weigh four to five pounds, but a big snake can reach six feet in length and weigh 12 pounds or more. The Eastern Diamondback is distinguished from other snakes by its large size, dorsal pattern of diamonds, yellowish unpatterned belly, dark tail with rattle, and infrared-sensitive pit between the eye and nostril.

Scientific studies over the past decade have documented range-wide population declines and significant range contractions for the Eastern Diamondback Rattlesnake: (1) The Eastern Diamondback Rattlesnake is absent or extremely rare across large portions of its former range. It has essentially been extirpated in Louisiana, is endangered in North Carolina, has limited ranges in South Carolina, Alabama, and Mississippi, and has become uncommon in much of Florida. It is also declining in Georgia; (2) The rate of population decline is unknown, but estimates indicate that just 3% of the historic population remains; and (3) Analysis of data from four rattlesnake roundups in the southeastern United States showed a steady decline in the weights of prize-winning Eastern Diamondback Rattlesnakes and the number collected.

Adapted from a news release distributed by the Center for North American Herpetology (CNAH)

Blue Iguana Hatchlings at the San Diego Zoo

The San Diego Zoo Institute for Conservation Research announced the hatching of two clutches of Grand Cayman Blue Iguanas (*Cyclura lewisi*). The parents were imported to the U.S. as youngsters in 2005 as part of the conservation strategy for the Association of Zoos and Aquariums (AZA) Rock Iguana Species Survival Plan (SSP) and the Blue Iguana Recovery Program (BIRP). The first clutch of two hatchlings was a first-time breeding event for sire and dam and perpetuates two founder lineages (Daniel and Carley) new to the U.S. captive population. The second set this year consisted of seven hatchlings and was the fourth clutch for their parents and their largest to date. The Cyclura SSP now manages 50 *C. lewisi* among 13 partner zoos. These offspring bring the captive population closer to the goal of mirroring the genetic diversity remaining in the wild. The SSP also has been encouraged by breeding behavior observed earlier this year between two previously unbred males and their new mates, whose transfers were recently organized between partner zoos (Indianapolis, Shedd Aquarium, Gladys Porter, and Central Florida).

Tandora Grant
San Diego Zoo Institute for Conservation Research

KEN BOHN, SAN DIEGO ZOO GLOBAL

Two of seven hatchling Grand Cayman Blue Iguanas (*Cyclura lewisi*) that comprise their parents' largest clutch to date.

Ozark Hellbender Listed as Endangered

The U.S. Fish and Wildlife Service has designated the Ozark Hellbender (*Cryptobranchus alleganiensis bishopi*) as endangered under the federal Endangered Species Act (ESA) and also finalized its decision to list the Ozark and Eastern Hellbenders in Appendix III of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In combination, these listings will provide significant protection to Hellbenders, both domestically and internationally.

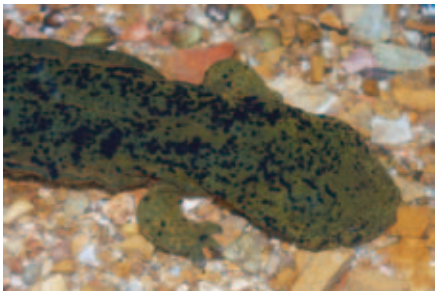
Under the ESA, an endangered species is any species that is in danger of extinction throughout all or a significant portion of its range. Ozark Hellbenders inhabit the White River system in southern Missouri and northern Arkansas. Ozark Hellbender populations have declined an estimated 75% since the 1980s, with only about 590 individuals remaining in the wild. Numbers have dropped because of degraded water quality, habitat loss resulting from impoundments, ore and gravel mining, sedimentation, and collection for the pet trade. Also threatening the Ozark Hellbender is a fungal disease, chytridiomycosis (chytrid), and severe physical abnormalities (e.g., lesions, digit and appendage loss, epidermal sloughing), which most Ozark Hellbenders exhibit.

The average age of Ozark Hellbenders is increasing and few young are being found, indicating problems with reproduction or juvenile survival. This, and the multiple threats from disease and habitat degradation, could lead to extinction of the Ozark Hellbender within 20 years.

"The Ozark Hellbender faces extinction without the protection afforded by the Endangered Species Act," said Tom Melius, the Service's Midwest Regional Director. "Listing provides tools and an infrastructure within which partners can pool resources and expertise to help save this species."

The Service determined that designating critical habitat under the ESA for the Ozark Hellbender is not prudent because the designation would require publication of detailed descriptions of Hellbender locations and habitat, making illegal collection for the pet trade more likely.

To better control and monitor the international trade of Hellbenders, the Service has included both the Ozark and Eastern Hellbenders in Appendix III of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES is an international agreement between governments designed to prevent species from becoming endangered or extinct as a result of international trade. Collection within the United States and international trade of Hellbenders is of growing concern, particularly as they become rarer and consequently more valuable. Listing Hellbenders in Appendix III of CITES would aid in curbing unauthorized international trade, not only by controlling exports from the United States but by enlisting the assistance of 174 other countries that are CITES Parties in controlling trade in the species.



SUZANNE L. COLLINS, CNAH

Hellbenders (*Cryptobranchus alleganiensis*) are among the world's largest salamanders, growing to total lengths of over 70 cm.

Currently, two subspecies of Hellbenders are recognized, the Ozark Hellbender and the Eastern Hellbender (*C. a. alleganiensis*), but recent studies have shown that additional lineages might be worthy of recognition at even the species level. The Ozark Hellbender occurs only in Missouri and Arkansas, whereas the range of the Eastern Hellbender includes portions of 16 states (Alabama, Georgia, Illinois, Indiana, Kentucky, Maryland, Mississippi, Missouri, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia).

Hellbenders have large tails and tiny eyes, and their flattened bodies enable them to move in the fast-flowing streams they inhabit. Hellbenders are habitat specialists that depend on constant levels of dissolved oxygen, temperature, and flow in their aquatic environment. Even minor alterations to stream habitat are likely detrimental.

The Endangered Species Act makes it illegal to kill, harm, or otherwise "take" a listed species. The ESA also requires all federal agencies to ensure that actions they authorize, fund, or undertake do not jeopardize the existence of listed species, and directs the Service to work with federal agencies and other partners to develop and carry out recovery efforts for those species. Listing also focuses attention on the needs of the species, encouraging conservation efforts by other agencies (federal, state and local), conservation groups, and other organizations and individuals.

The listing of the Ozark Hellbender under the ESA will take effect 30 days after publication of the final rule on 6 October 2011, whereas the listing of Hellbenders in CITES Appendix III will take effect 180 days after publication of the final rule. This additional time is necessary so that the Service can submit required documentation to the CITES Secretariat, which will then notify all CITES Parties of this action taken by the United States.

Editors' Remarks

The individuals listed below have reviewed submitted manuscripts during the past year. We thank **Aaron M. Bauer, Craig S. Berg, Jeffrey T. Briggler, Sandra D. Buckner, Rebecca Christoffel, C. Kenneth Dodd, Jr., Richard M. Engeman, Jeff Ettling, Claude Gascon, Matthew E. Gifford, Rafael L. Joglar, Fred Kraus, William W. Lamar, Michael Lau, Day B. Ligon, James R. McCranie, D. Bruce Means, Walter E. Meshaka, Don Moll, Chad E. Montgomery, Saúl S. Nava, Max A. Nickerson, William S. Parker, Stesha A. Pasachnik, Robert N. Reed, Gordon H. Rodda, Christina M. Romagosa, Philip C. Rosen, Roger S. Thorpe, Peter J. Tolson, Rod D. Wittenberg,** and **Kevin C. Zippel**. In addition, the following editors and members of the editorial board provided formal reviews during 2011: Robert W. Henderson, Charles R. Knapp, Gad Perry, and Robert Powell.

The Editors of Reptiles & Amphibians

STATEMENT OF PURPOSE

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The IRCF encourages contribution of articles, letters to the Editor, news items, and announcements for publication in *REPTILES & AMPHIBIANS*. General articles can deal with any aspect of reptilian or amphibian biology, including conservation, behavior, ecology, physiology, systematics, or husbandry. Submission of photographs to accompany articles is encouraged. Guidelines for submissions and figures are at www.ircf.org/about/submissions. Manuscripts may be submitted via e-mail (send to AJ@IRCF.org). Authors of one page or more of print will receive a free copy of the journal in which their contribution appears, and will receive a PDF file of their article for distribution.

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FOCUS ON CONSERVATION

Teaching Module on Declining Amphibians Now Available as a Free Download

Now available, via the Network of Conservation Educators & Practitioners (NCEP; a program of The American Museum of Natural History), is an outreach teaching module reviewing all aspects of the global crisis of amphibian declines and extinctions. The module includes a thoroughly annotated and illustrated PowerPoint presentation, an overview Synthesis monograph with extensive literature citations, as well as proposed in-class teaching exercises and solutions. The module is aimed toward university-level students (e.g., Conservation Biology or Herpetology courses), but it is open-format, so it can be edited and customized for any particular need or audience. A sample panel appears below.

The citation and link for the free download are:
Mendelson, J.R., III and R. Donnelly. 2011. The Crisis of Global Amphibian Declines: Causes, Consequences, and Solutions. Network for Conservation Educators and Practitioners, American Museum of Natural History, New York.

CD-ROM. System requirements: IBM PC or Mac compatible. Windows 98 or higher. Also available electronically at: (PowerPoint Teaching Tutorial, plus associated pedagogical materials) 97+ pp. (http://research.amnh.org/biodiversity/ncep).

The authors also are actively seeking K–12 and other educators to collaborate in the preparation of modules appropriate for non-university students and public audiences. For more information or copies of these materials, please contact Joe Mendelson (jmendelson@zooatlanta.org).

Land-Use Change

Amphibians respond, usually negatively, to all forms of altered habitats, including very subtle changes in leaf-litter layers, soil compaction, or hydrological parameters.

Some Examples for the USA:

- Arroyo Toads in California lose entire clutches of eggs because river flood control programs release scouring pulses of water just after toads have reproduced, destroying entire cohorts of eggs or larvae (Sweet and Sullivan 2005).
- Shenandoah Salamanders in Virginia are losing all of their tiny remnant habitat to alteration of forest canopy cover resulting from herbivory from introduced gypsy moths (Mitchell 2005).
- Valdina Farms Salamanders in Texas had their only known locality submerged briefly by a nearby dam project in the 1980s; exotic catfish invaded the site and no salamanders have been seen since (Chippindale 2005).

B. GRATWICKE

Arroyo Toad (*Anaxyrus californicus*)

C. BROWN, USGS

Shenandoah Salamander (*Plethodon shenandoah*)

Notes:
Recall the importance of water and humidity to the survival and reproduction of amphibians. Even subtle changes in local vegetation, level or timing of water flow in a creek, or water temperatures can negatively impact amphibians. Realize that the "land-use change" may involve more than just alteration of vegetation (e.g., deforestation) or soils (e.g., plowing), but may be accompanied by chemicals (e.g., herbicides on a farm) or streetlights that make amphibians more visible to predators. A few amphibians appear to be very tolerant of habitat alterations around them and may persist even in environments as degraded as a vacant lot in a major city or a golf course.

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Texas Horned Lizards (*Phrynosoma cornutum*) were historically distributed across much of Texas, but recent studies indicate that the species is declining across much of its range (see article on p. 208).