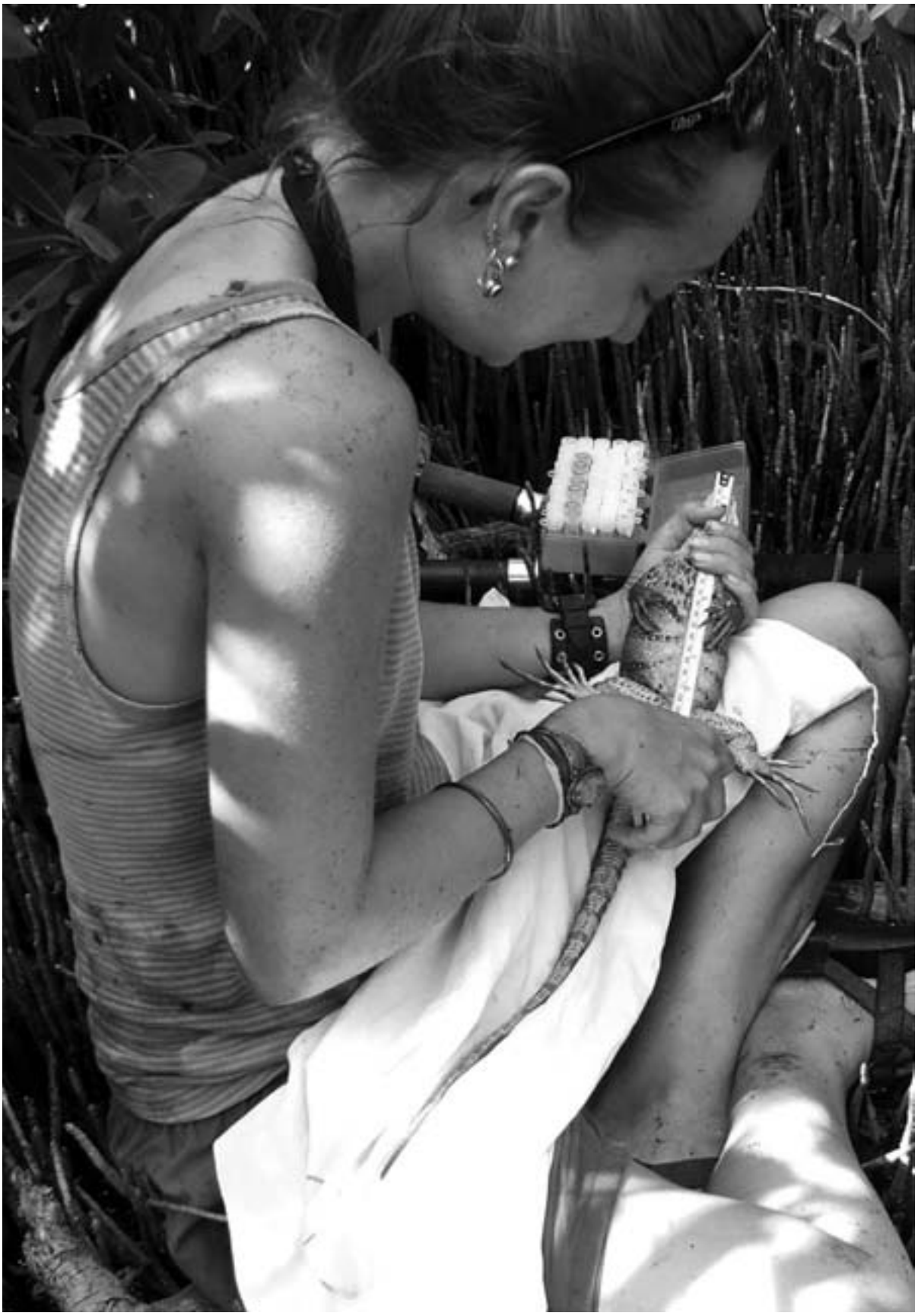

DENNIS BAULECHNER

The author processing a ctenosaur in the mangrove swamp on Utila.

Ctenosaurs of Honduras: Notes from the Field

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Photographs by the author except where noted.

Mesoamerica is one of the most biologically diverse areas in the world. Iguanid lizards comprise a conspicuous component of this diversity, largely due to the species-rich genus, *Ctenosaura*. This genus encompasses 17 distinct species (more than twice as many as the second most diverse genus, *Cyclura*). These lizards are threatened with extinction by habitat destruction and fragmentation, over-harvesting, pollution, and exportation for an illegal pet trade (four of the five largest threats to biodiversity). In 2004, ten species in this genus were Red-listed by the IUCN. Four of five species listed as critically endangered form the *Ctenosaura melanosterna* clade. In order to address the high degree of intra-generic diversity, gain an understanding of the threats faced by these critically endangered species, and aid in their protection, I plan to do a multi-scale molecular evaluation of the clade and its wide-ranging and sympatric congener, *C. similis*.

One principal goal of my research is the construction of a molecular phylogeny of the *Ctenosaura melanosterna* clade, which occurs along the Caribbean versant of Honduras and Guatemala and on the Honduran Bay Islands. When added to recent studies of the southern sister clade, the *C. quinquecarinata* complex, this work will complete the phylogenetic analysis of ctenosaurs in southern nuclear Mesoamerica.

A second component of this project will address the threat that habitat destruction poses to *Ctenosaura bakeri*, endemic to the Bay Island of Utila, by evaluating the degree and direction of genetic introgression with *C. similis*. These hybridization events may result from a novel overlap in the ecological distributions of these species that resulted from habitat destruction. A detailed management plan will recommend methods of preserving the genetic integrity of *C. bakeri*.

Destruction of what had been a mangrove stand southeast of the canal on Utila.

DENNIS BAULECHNER

The author (left) and Hadas Grushka, a volunteer from Israel, noosing ctenosaurs from an incomplete foundation.

The third portion of this investigation concerns the colonization by *Ctenosaura bakeri*, *C. similis*, *C. melanosterna*, and *C. oedirhina* of the Bay Islands, Cayos Cochinos, and various islets in the Caribbean Sea bordering Honduras. This will allow for insight into evolutionary rates and patterns within this clade. Additionally, due to ecological and hybridization threats that *C. similis* poses to *C. bakeri*, dating the arrival of the former on Utila will be necessary to determine if it is an invasive species.

During the spring and summer of 2006, I spent six months collecting data on *Ctenosaura melanosterna*, *C. bakeri*, *C. oedirhina*, and *C. similis* populations throughout their respective ranges in Honduras. The goal of this preliminary report is to discuss the success of collecting DNA samples and the current status of the populations of these species. Later reports will discuss my molecular findings.

Southern Honduras (March)

Department of Choluteca.—Along the main highway, we encountered children selling *C. similis* and *Iguana iguana* and

were able to obtain tissue samples from four *C. similis*. These children told us that, in an effort to be sustainable, they only catch males. We could not confirm that contention, but I see no reason for them to lie, since hunting iguanas at all is illegal. In an area locally called La Bonanza, we again encountered children selling *C. similis* and *I. iguana*. We obtained tissue samples from three more *C. similis*, before traveling north along a dirt road toward the town of El Triunfo, where we caught a juvenile ctenosaur. Given the locality, this should have been *C. similis*, however, it looked strikingly like *C. flavidorsalis*. A genetic sample and subsequent molecular analysis should resolve this mystery. Inspired by a photo of what looked like *C. quinquecarinata* from this area (sent to me by Dr. Thomas Akre), I asked locals about this possibility. Apparently, *C. quinquecarinata* did and may still occur in this area, although we found no individuals.

Department of Valle.—In an area known as San Juan Pali, we encountered a man carrying a bag of ctenosaurs. We obtained tissue samples from four *C. similis*, but were unable to determine the sex of these individuals due to their condition. Locals at Playa Blanca helped us catch two additional lizards, one of which appeared to have been poisoned, a local technique for ridding gardens of iguanas. In San Pablo we hired a boat to take us to Isla del Tigre and Isla Exposicion. Although we saw many *C. similis* on Isla del Tigre, we were unable to catch any. Our visit to Isla Exposicion proved more successful. Aided by four local teenagers, we caught three male *C. similis*. Apparently, all of the sizable islands in the Golfo de Fronseco support ctenosaurs.

Hunting pressures on ctenosaurs in these southern departments are intense. Hunters have little fear of being caught. Additional molecular work from this area is desperately needed to determine if the *C. similis* in the area represent a unique gene pool. Intense field and molecular work also are needed to determine if either *C. flavidorsalis* or *C. quinquecarinata* are present.

Northern Honduras

Department of Cortez (July).—Locals in San Pedro Sula told us that ctenosaurs are not sold in markets due to the presence of law enforcement. We did, however, encounter both *I. iguana* and *C. similis* being sold along the highway north of the city. We obtained a tissue sample from one adult female *C. similis*. In Puerto Cortez, we searched for ctenosaurs in areas where they are normally sold, only to be told that it was the wrong season. However, one roadside "store" had "iguana" meat for sale. We could not determine what type of iguana this was due to its condition. Traveling west along the coast toward Omoa, we encountered many *C. similis*, but were able to obtain tissue from only one individual. In the small Garifuna village of Travesia, locals told us that they normally have many iguanas for sale, but it was not the right season for hunting iguanas.

Department of Atlantida (June and July).—In the towns of Miami and Tornabe, we obtained tissue from seven *C. similis*. Along the road from Tornabe to Miami and in the village of Miami, we saw many hatchlings, indicating that this is a very stable population, despite the presence of local hunters. In

Ctenosaura oedirhina from Barbareta, Roatan.

Ctenosaura oedirhina from along the Mangrove Canal on Roatan.

Miami, a grove of large Red Mangroves (*Rhizophora mangle*) provides habitat for many adult *C. similis*.

We hired a small boat to take us into the Punta Sal National Park, where we visited the areas of Puerto Carib and Cocolito. We caught seven hatchlings in Puerto Carib and six more in Cocolito. Additional molecular work is needed, but the population in the park seems to be reproducing well. The lack of encounters with adults was probably attributable to the very dense vegetation, although we cannot rule out hunting pressure.

Department of Colon (July).—Our time here was split between the coastal regions, where *C. similis* occurs, and the Valle de Aguan, where both *C. melanosterna* and *C. similis* occur. We obtained eight *C. similis* tissue samples from Sambo Creek, between La Ceiba and Trujillo. We stopped in many different towns and asked about ctenosaurs in markets, but were told each time that selling iguanas is illegal. *Ctenosaura similis* appears to be thriving in the gated area at Puerto Castillo. Guards, most likely representing the Standard Fruit Company, apparently provide protection for the ctenosaurs in this area. We easily caught three individuals. We then entered the Naval Base, where *C. similis* was similarly abundant, although catching them was impossible. My impression was that they are harassed but not hunted.

Along the road from Puerto Castillo and around Casa Kiwi, we found a good number of juvenile *C. similis*, the latter a result of protection provided by the New Zealand owners. We asked to collect tissue samples, but were told that no iguana could be harmed for any reason. Although disappointing for our study, such an attitude should help preserve *C. similis* in the area. We acquired two tissue samples west of Trujillo, one subadult female in the town of San Antonio and one sample retrieved from the tail of a *C. similis*, lost as it escaped into a hole.

Ctenosaura similis appears to be much less threatened in these northern coastal areas than in the south. Northern populations seem to be reproducing at good rates, and individual property owners seem to be taking an active interest in their preservation. However, illegal hunting does occur, but populations seem to be handling this threat.

In the Valle de Aguan, we acquired genetic samples from eight *C. melanosterna* and seven *C. similis*. Four *C. melanosterna* (two juveniles and two hatchlings) and six hatchling *C. similis* were captured north of the Río Aguan in an area known as Agua Caliente, and four additional *C. melanosterna* (three sub-adult males and one hatchling) and one hatchling *C. similis* were captured south of the river in the area around Arenal. The situation in this area is dire. Hunting pressure is greater than I have seen anywhere else, with the possible exception of southern Honduras. The threat is aggravated by the fact that this is the only continental area where *C. melanosterna* occurs. I did not see a single adult *C. melanosterna* and saw very few hatchlings. Hatchling *C. similis* were abundant, and the timing was such that hatchling *C. melanosterna* should also have been prominent — if they are indeed breeding. Given the reduced range of *C. melanosterna* and the anthropogenic factors involved, this population could be extirpated within a few years if action is not taken immediately. The Honduran government in past years was working on a reserve for endemic species. This effort, headed by Paul House, was to include a breeding program for *C. melanosterna*. This project is no longer funded and is at a standstill. The only alternative is a coordinated effort by international organizations and the COHDEFOR office in Olanchito, which recently has established a protected area in the Valle de Aguan, and is in the process of building a visitor/research center on site. At present, guards watch over this area, and I strongly recommend that a breeding program be implemented within that reserve.

Cayos Cochinos (June)

The Cayos Cochinos Archipelago is protected by the Honduran Coral Reef Foundation (HCRF), which has set up a National Marine Reserve that encompasses all of the islands in the archipelago. We spent approximately one week on both Cayo Pequeno and Cayo Grande, the only islands of the archipelago where ctenosaurs are found. Although both islands are technically protected under Honduran law, Cayo Pequeno has increased protection due to the presence of a research station, founded by the HCRF. This allows *C. melanosterna* to thrive, because both hunting and habitat destruction have stopped. We caught eleven individuals from this island. Cayo Pequeno is extremely small and has no obvious physical barriers, so I consider animals from the entire island as one population. Work on Cayo Grande proved to be much more difficult. Lizards were very skittish and the island itself is much larger. We nevertheless caught nine animals, all from one area. Based on the lizards'

behavior and the absence of large individuals, we concluded that *C. melanosterna* probably is being hunted regularly on Cayo Grande by the Garifuna people living on this island. Locals who helped us came equipped with dogs and slingshots, tools typical of mainland iguana hunters. Mainland Hondurans also may hunt on the island and return to the mainland to sell their catch, as the *C. melanosterna* on the island are much easier to catch than *C. similis* on the mainland.

Isla de Roatan (June)

We caught 25 *C. oedirhina* at six sites that were spread fairly evenly throughout the island. Five individuals were caught from the West Bay area. This area is the site of ongoing development, where clearing in the past has opened up a rocky area in which ctenosaurs seem to thrive. We saw no physical evidence of hunting in this area, although a local, intrigued by our efforts to dig ctenosaurs out of the rocks, quickly jumped in and caught one for us. Additionally, we saw very few adults, which could be indicative of hunting. We caught six individuals at the Paya Bay Resort on the northeastern half of the island. Interestingly, ctenosaurs are abundant on the open rock faces abutting the ocean, and locals have told us that they often see them in the ocean, although I was unable to confirm this with my own observations. Four individuals came from Arch's Iguana Farm. Although this "farm" is dedicated to the preservation of Green Iguanas (*Iguana iguana*), a few *C. oedirhina* can be found in the area. Through the efforts of one of the farms caretakers, ctenosaur breeding may be incorporated into the farm's objectives. This would be of great benefit to the species, and considerations should be given to helping him with such an effort.

We hired a dory to take us through the Red Mangrove Canal. This is a tourist route, and was recommended as a place to find ctenosaurs. We were able to catch four individuals from this area in about one hour. Hunting pressure appears to be low, at least in part because the ctenosaurs are a tourist attraction. We took a second dory trip to the far eastern end of the island and to the two small islands of Morat and Barbareta. Barbareta is a private island that is heavily guarded against local poachers of Green Iguanas, ctenosaurs, and sea turtles. The owner of the resort on this island seems to be very concerned with protecting the wildlife. With the assistance of two guards, he allowed us to collect samples from five individuals. Our trip to Morat was unsuccessful. We examined the entire southern side of the island, but saw no signs of any kind of iguana. We saw no tail drags, evidence of nesting or hatching, or fecal matter. We also saw no clear signs of hunting, although branches had been cut off the mangrove trees, the pattern was not typical of ctenosaur hunting. Santa Elena, located on the far eastern side of Roatan, also proved unsuccessful, although we did see one individual. We stopped farther west at Rocky Point and saw many ctenosaurs, but were unable to catch any as they were extremely skittish. Hunting pressure on the far eastern side of the island appears to be high.

The situation for *C. oedirhina* on Roatan seems to be fairly good, although the fact that hunting is occurring was no secret. The island seems to be big enough and contain enough protected areas to conserve this species. *Ctenosaura oedirhina* also seems to be able to exploit many different environments, from Red Mangrove stands to dry scrub forest, indicative of its ecological versatility, a characteristic that should help this species as habitats change or are destroyed. I propose that conservation efforts focus on the populations on Barbareta and at Arch's Iguana Farm.

Isla de Utila (March–May)

On Utila, I continued and expanded work initiated in 2005, which included mark-recapture, collection of DNA samples, and ongoing evaluations of the status of *C. bakeri* and *C. similis*, with particular efforts aimed at assessing the possibility of hybridization between the two species. In addition to sites visited last year, I discovered many new sites, some of which support only *C. bakeri* or *C. similis*, whereas others have both species. In all, I identified 26 sub-sites located throughout the island. These sub-sites can be grouped into three main geographic regions based on both anthropomorphic and natural barriers and useable habitat connections.

Geographic region one (GR1) encompasses the most easterly portion of the island and is divided from geographic region two (GR2), which encompasses the middle section of the island, by the presence of Utila Town in the south and uninhabitable savannah through the interior of the western part of the island. These barriers may be more of a problem for *C. bakeri* than for *C. similis*. GR1 includes five sub-sites, of which one is occupied solely by *C. similis*, one solely by *C. bakeri*, and three have both species. We captured a total of 71 *C. bakeri* (30 males, 32 females, 9 juveniles) and 31 *C. similis* (five males, 15 females, 11 juveniles) in GR1.

Typical locally made noose found near the Tradewinds properties.

Ctenosaura bakeri from northwestern Utila.

Geographic region two encompasses the middle section of the island on both the eastern and western sides of the canal and is separated from geographic region three (GR3) by the presence of uninhabitable savannah running essentially north-to-south through the western section of the island. Although a man-made canal runs north-to-south through the middle of GR2, it is not a geographic barrier for ctenosaurs, because it is extremely shallow in many areas and trees occasionally form a contiguous canopy over the water. This barrier, however, may affect *C. similis* more than *C. bakeri*. GR2 includes 17 sub-sites, two occupied solely by *C. similis*, 12 solely by *C. bakeri*, and three support both species. We captured a total of 271 *C. bakeri* (118 males, 114 females, 39 juveniles) and 20 *C. similis* (six males, nine females, five juveniles) in GR2.

Geographic region three is the largest region and encompasses the most westerly portion of the island. GR3 includes eight sub-sites, five occupied solely by *C. bakeri* and three include both species. We captured a total of 40 *C. bakeri* (14 males, 15 females, 11 juveniles) and five *C. similis* (1 female, 4 juveniles) in GR3. We spent substantially less time collecting in GR3 due to the difficulty of reaching the area.

I can now conclude that *C. bakeri* can be found in nearly all areas of the island, with the sole exception of the savannah. Although traditionally thought to be a mangrove specialist, *C. bakeri* may actually be more of a generalist. Although they thrive in mangroves, I also found them doing well in dry areas that were once thought to be occupied solely by *C. similis* or to be entirely ctenosaur-free. This may be an artifact attributable to habitat destruction, but occupied areas on the northwestern side of the island, which are virtually free of people, argue otherwise. Additional observations from the eastern shore indicate that *C. bakeri* often exploits dry beaches far from mangroves stands, even during periods other than the breeding and nesting seasons. Similar to *C. oedirhina* on Roatan, I suggest that *C. bakeri* can be considered a habitat generalist that is adept at exploiting mangrove swamps. However, on Utila, *C. bakeri* shares the island with a congener (*C. similis*) that appears incapable of surviving in the mangroves.

I also visited many of the small cays off the southwestern and western coasts of Utila, and found no evidence of iguanas. My purpose on these cays was to check for the presence of ctenosaurs and evaluate them for the possible introduction of *C. bakeri* rescue populations. The only cay that might be able to support iguanas is Bird Cay, which offers suitable habitat and is free of human visitation. However, the island is very small and could support only a small population of lizards.

I was unable to recapture enough individuals to estimate accurately population or subpopulation sizes. This may reflect

Ctenosaura similis from a new development on the eastern side of Utila.

Cleared area on the eastern side of Utila at the Blue Bayou lagoon.

Dead *Ctenosaura similis* hit by a four-wheeler on the road near Annie Marelli's Hotel.

the fact that only 100 individuals were marked in 2005 or it may be attributable to the recent increase in iguana hunting on the island. Although questions regarding hybridization between the two species will be addressed more conclusively once molecular evidence can be taken into account, I found no obvious morphological evidence suggesting that hybridization occurs more than very rarely, supporting tentative conclusions based on molecular work in 2005.

Although populations of *C. similis* and *C. bakeri* on Utila seem stable at this time, hunting, development, and traffic on the island have increased dramatically in just the past year. In 2005, I rarely saw hunters or signs of hunting. In sharp contrast, I rarely had a day in the field this year during which I did not encounter hunters, find evidence that people had been hunting, or hear people hunting with guns. Additionally, habitat destruction continues to threaten the wildlife of Utila, particularly the illegal destruction of mangrove forests. Utila's roads and associated traffic also are expanding. This year, for the first time, I found road-killed ctenosaurs. I strongly recommend support of the habitat action plan being developed by the Utila Iguana Research and Breeding Station to buy land, give land owners incentive to be ecologically friendly, and hire guards to protect wildlife.

Summary

Honduran ctenosaurs face many threats. In the south, the greatest threat is illegal poaching. In the north and on the islands, in addition to illegal hunting, the greatest threats are habitat destruction and a growing human population. Throughout the country, the sporadic or total lack of law enforcement that should have been protecting these animals since 1994 leaves them vulnerable. In 2004, the IUCN listed all of these ctenosaurs, except *C. similis*, as "critically endangered," indicating the severity of the situation. Without local protection, their future is questionable at best. Only those individuals and institutions that feel a moral obligation to protect the diversity of nature can postpone the seemingly inevitable extirpation of at least many populations.

Acknowledgements

The success of this field season would have been impossible without the help of many amazing volunteers: Dennis Baulechner, Corey Shaffer, Jeff Liechty, Wendy Naira, Melissa Issis Medina, Sammy Nuñez, and Hadas Grushka, my thoughtful mentors Drs. Arthur Echternacht, John Iverson, and Tom Near, The Utila Iguana Research and Breeding Station, The Overseas Research Station on Roatan and Dr. David Evans, The Cayos Cochinos Foundation, Dr. Gustravo Cruz, Jorge Ferrari, and the many offices of AFE-COHDEFOR. Additional thanks go to Oscar Maccio, Colin Meeks, and Martin Nuñez for aid in translating the report on which this article is based.

References

Abdelkrim, J., M. Pascal, and S. Samadi. 2005. Island colonization and founder effects: The invasion of the Guadeloupe islands by Ship Rats (*Rattus rattus*). *Molecular Ecology* 14:2923–2931.

Hasbun, C.R., A. Gomez, G. Kohler, and D.H. Lunt. 2005. Mitochondrial DNA phylogeography of the Mesoamerican Spiny-tailed Lizards (*Ctenosaura quinquecarinata* complex): Historical biogeography, species status and conservation. *Molecular Ecology* 14:3095–3107.

Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca, and J. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403:853–858