Iguana Specialist Group

Newsletter

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Iguanas in the News

In the Bahamas, Some Islanders Indulge a Taste for the Dwindling Iguana
Miami Herald - July 7, 2002
By Curtis Morgan

"No, man, nobody eats the iguana anymore." Rufus Saunders smiles into his taxi rear-view at the question from wildlife biologist Joe Wasilewski. The appetite for the spectacular lizards of Andros, among the largest iguanas in the world, has all but vanished with old-timers, Saunders assures him. "But if you catch one, Joe, bring it to me," the taxi driver says, delivering his punch line with laughter. "Once you've had iguana, you'll never want steak again."

The iguana that Wasilewski has come to see is one of 17 sprinkled across the Bahamas, Jamaica, Cuba and other islands that the World Conservation Union collectively considers "among the most endangered of the world's lizards." They all face common threats. Development consumes arid forests where they dwell. Goats and cows munch native plants they feed on. Cats, dogs and hogs fatten up on eggs and young lizards. But there is an additional concern for the Andros Island iguana. Islanders may be helping to eat them toward oblivion. Though the iguana has been protected by Bahamian law for more than 30 years, its reputation as favored Androsian fare has stubbornly persisted, says Eric Carey, wildlife conservation officer for the Bahamas' Department of Agriculture. "I have been told by local people that they are still eating iguanas," Carey said, "but we don't know what the real threats are or even how many of these animals are left."

For the first time, researchers are making major strides toward answering many of those questions about the iguana of Andros, where razor-edged rock, thorny scrub and thirsty mosquitoes make scientific scrutiny difficult and potentially hazardous. Some of the groundbreaking work is being done by Chuck Knapp, a conservation biologist with the Shedd Aquarium in Chicago, who is conducting the first comprehensive survey here. After four years of forays into treacherous terrain, Knapp has charted declines serious enough that he intends to recommend to the conservation union that the iguana be downgraded from "vulnerable" to the more serious "endangered." A population that once numbered 20,000 has dwindled to ''no more than 5,000," Knapp says. And that's likely an optimistic estimate based on the fact that so much of the clump of mangrove-fringed islands that make up Andros, the largest land mass in the Bahamas, remains sparsely populated with just 8,000 people. Still, the pressure of those few people, most living on the northern part of an island where old logging roads

crisscross a prime iguana habitat, has pushed most remaining lizards to the largely unspoiled middle and south sections and cays. "Up north," said Knapp, "they're just about gone."

That assessment applies to more than a dozen iguanas from the Bahamas to Martinique, native creatures that go back millions of years. Isolated to small islands, they've evolved into eight separate species of iguana and 16 subspecies, says Allison Alberts, chief of applied conservation for the Zoological Society of San Diego and co-chair of the World Conservation Union [sic], the group of scientists that developed a protection plan for the lizards two years ago as populations slipped toward collapse. One, the Jamaican iguana, was actually considered extinct before a wild hog hunter's dog caught one in 1990, leading to the discovery of a wild population numbering fewer than 100. It and several other species, confined to only one or a handful of islands, are considered at critically high risk.

"Some of these iguanas are functionally extinct," said Wasilewski, a Homestead biologist who is president of the nonprofit International Iguana Society, formed to help protect the lizards. "These are magnificent creatures, and we don't want to see them disappear."

In the wild, the iguanas are mesmerizing, literally down-sized dinosaurs, and strikingly beautiful despite scaly skin and horns. The Andros iguana appears dusted in charcoal soot, a darkness offset by intensely colored splashes of coral and mustard. Until the introduction of European exotics like dogs and cows, they were the largest land animals on the islands — reaching five feet in length and 20 pounds in the case of the Andros and Cuban varieties.

Until Knapp began his surveys, there had been no accurate counts and scant field studies of the Andros iguana. Little was known about nesting, aside from its habits of laying a clutch of four to 15 eggs in termite mounts. Knapp, who is studying the iguanas as part of his doctoral work at the University of Florida, has already documented a number of previously unobserved behaviors, including one that might be considered heartwarming if the creatures weren't cold-blooded. For about three weeks after laying eggs, females refuse to leave their nests, guarding them against other females. Despite being surrounded by humans, one iguana held her ground, repeatedly scrambling atop the crumbly soil clump where something — snakes or crabs, perhaps — had already eaten her eggs. "It's just the instinct to protect," Knapp said.

Chuck Knapp checks a South Andros Island iguana that he tagged with beads. Photo by Marice Cohn Band.

He also intends to survey the culinary habitats of islanders, but his initial findings haven't been as rich. Knapp found one legendary hunter, a North Andros man who goes by "Old Iron," who still claims to fill regular orders for iguana, and Knapp has seen enough spent shotgun shells on cays to know somebody is still out there eating lizards. But most younger generations seem to offer a reflexive smirk at the suggestion. And older folks like taxi driver Saunders and Leroy Bannister, an 85-year-old spinner of yarns and wisdom on nearby Mangrove Cay, freely admit to a past of spearing, shooting and tracking iguanas. But they also say they stopped after 1968, when the government passed a sweeping wildlife law that outlawed the killing of iguanas. "If anything", said Bannister over a cold Kalik in his waterside bar, the Aqua Marine Club, "there are more iguana than ever. They're out there in the bush, but you have to know where to find them."

Andros, of course, isn't the only island where people have eaten iguana, but biologists and Bahamian authorities believe it is one of the last islands where the lizard is still regularly pursued. With a culture and economy largely untouched by the glitz of Nassau, a large lizard provides a ready supplement to the diet of spongers, crabbers and others who struggle to live off the sea and land. "If they don't necessarily find a hog, which they go in search of, they'll take an iguana," said Sandra Buckner, an iguana authority and past president of the Bahamas National Trust, which manages the islands' national parks.

For those trying to save the iguana, there are some encouraging signs that tastes will change with time and education. Bahamian authorities have encouraged school visits by Knapp, whom locals have taken to calling "iguana man," and he's printed up ''Save the Andros Iguana" T-shirts to further spread the message. The government, says Buckner, also has set aside land for ten new parks this year, including five areas on Andros, and the research of Knapp and others may yet uncover populations hidden deep in the interior. And, as an eco-tourism industry emerges on Andros with the promise of money, many islanders seem to be coming to value the iguana in a new way, says Carey, the Bahamas wildlife conservation officer. "People are going to be more inclined to seeing the animal alive than in the pot," he said.

Iguana Traumas in the Bahamas

Boston Globe - December 31, 2002

By Emily Sohn

SAN SALVADOR, Bahamas - Biologist Bill Hayes crouches down on his knees, holding an apple slice out to a wary iguana. "Ron, look how fat he is!" he says to his colleague, Ron Carter. Both are from Loma Linda University in California and, for the first time, they are checking out a small group of iguanas that live at a Club Med resort on San Salvador Island in the Bahamas. To their surprise, the cat-sized lizards look exceptionally healthy. "He's so fat compared to what we normally see." The red-hued iguana bobs its head, but doesn't budge from its spot 5 feet away. "He's saying: 'I want grapes, not apples,'" Carter says.

Few Bahamian iguanas can afford to be so picky. All eight species of Rock Iguanas that live in the West Indies are among the most endangered lizards in the world. The San Salvador species - one of three that live in the Bahamas - are in especially bad shape. Fewer than 300 individuals remain. But hope for their survival is slowly building, thanks to Hayes, Carter, and a handful of other dedicated researchers. Through educational projects and long-term studies, lizard scientists are coming up with new models for conservation, including relocating the iguanas to more hospitable areas, and the still-controversial idea of letting the reptiles run wild in the protected confines of resorts like Club Med.

Arriving from the South American mainland more than 25 million years ago, iguanas used to live all over the Caribbean. But, as people and their pets have overtaken the islands, iguana populations have plummeted. Some iguanas are caught for the pet trade, and some people still hunt the lizards for food despite laws prohibiting the practice. And tour boats routinely visit certain islands, bringing hundreds of tourists to see - and often disturb - the animals, according to biologist John Iverson of Earlham College in Richmond, Ind. "I've seen people throw Styrofoam, raw hamburgers, you name it. Anything people on a boat could throw out, they do." The animals can get sick and die from eating things they're not supposed to, and the more they get used to people, the easier they are to catch.

But feral animals may be the biggest threat to the iguanas' existence. When Iverson started his research in the Turks and Caicos in 1978, an estimated 15,000 iguanas covered a deserted island that measured only two square miles. When construction began on a luxury hotel, workers started moving to the island with their dogs and cats. The pets saw the reptiles as prey, and the iguana population began to plummet. Just three years later, only a handful of iguanas remained.

The first step toward saving iguanas, most researchers say, is learning more about their basic needs. Iverson, for one, has been going to the Exumas island chain in the Bahamas every year for 22 years to collect data on the Allen Cays iguanas, making his the longest ongoing study of iguanas ever. "Because it is a long-term study," he said, "we have been able to amass information on growth and aging that no one has on any other lizard population in the world."

His research has shown, for example, that Allen Cays iguanas can live for more than 40 years and that it takes them at least 12 years to reach sexual maturity. Preliminary evidence from Iverson's ongoing project suggests that Allen Cays iguana females may reproduce only once every three years. There are fewer than 1,000 Allen Cays iguanas left on only two islands, making them especially vulnerable to storm surges and other threats. "If it takes them 12 to 14 years to be mature, and when they get to be mature, they only nest once every three years," Iverson said, "it's going to take a long time for a population to recover if something terrible happens."

Cyclura riley rileyi *on Green Cay. Photo by Tandora Grant.*

To avoid that kind of catastrophe, experts stress the importance of protecting critical habitats, and the Bahamian government has been moving in that direction with the recent designation of ten new national parks. But enforcement is difficult in a country made of 700 scattered islands.

Trying to save the iguanas, several research groups have been relocating iguanas to new islands that provide plenty of food and places to hide, with fewer people, animals, and other threats. So far, the strategy seems to be working. In one case, Iverson moved eight iguanas from the Allen Cays to a small island nearby with a similar habitat. Now, 10 years later, there are more than 80 individuals in the transplanted population. "This island population is just growing by leaps and bounds," he said. "Now, we have an auxiliary population should something happen to the others."

Similarly, researchers from the San Diego Zoo moved 200 iguanas last year from a particularly threatened island in the Turks and Caicos to several other regions where the animals used to live. Already, the transplanted

iguanas have started reproducing, and they appear to be growing rapidly, said San Diego Zoo conservation biologist Allison Alberts. "They're doing just great," she said. "We're really thrilled with that."

The lesson is simple, said biologist Chuck Knapp of the University of Florida at Gainesville, who is studying both iguanas and people's reactions to them on Andros Island, in the northern Bahamas. "Iguanas can be a flagship species for conservation," he said. "If people leave them alone, they'll do fine."

Even people who live far from the tropics can do their part to help, Iverson said, by resisting the urge to buy West Indian iguanas as pets. Just like South American green iguanas, which are not endangered, the West Indian iguanas require a much bigger commitment than most people realize because they live so long and grow to be so huge. "Don't buy on impulse a cute little baby iguana," Iverson said. "I know people who will probably die before their iguana does."

Surprisingly, tourism also may be one of the keys to saving Bahamian iguanas, suggests some serendipitous research on San Salvador. Ten years ago, tour guides from the Club Med on the island snagged a handful of endangered San Salvador iguanas from nearby Green Cay and brought the animals back to the resort for a tourist attraction. For the first time this October, Hayes and Carter were given access to the Club Med reptiles, where they caught and measured three of the estimated 15 iguanas there. The results were striking, Hayes said. "All three were just way off the scale. They were far and away larger than anything we've caught on Green Cay."

The Club Med iguanas are probably so successful, the researchers say, because they have more food, more places to hide, and protection from feral animals. Last year, the Club Med iguanas even started reproducing. But experts remain cautiously optimistic about the potential to use hotel resorts as models for conservation. It would be easy for tourists to steal the reptiles, which can sell for up to $4,000 on the black market, or feed them the wrong kinds of food. Careful monitoring would be essential. "Our initial feeling was that this is terrible," Hayes said. "But now we're starting to see that maybe this is not such a bad idea." Even iguanas, it seems, might benefit from a Club Med vacation.

The following press release was distributed July 23, 2002 and became the basis for numerous newspaper articles in the US and internationally.

International Iguana Foundation Leads International Effort to Save Grand Cayman Blue Iguana from Extinction

Prompted by alarming new statistics on the population of the Grand Cayman blue iguana, scientists sponsored by the International Iguana Foundation (IIF) are mobilizing a response to this crisis that could involve the removal of the last remaining wild specimens to the safety of captivity. Such a move would be similar to the efforts to rescue the California condor nearly 20 years ago, which has become a highly successful conservation program.

In a report issued June 22, 2002 by Fred Burton, Director of the Iguana Recovery Program of the National Trust for the Cayman Islands, it is estimated that only 10 to 25 blue iguanas remain in the wild (down from 100 to 200 estimated in a 1993 survey). The new population figures make blue iguanas one of the most critically endangered reptile species in the world. Including blue iguanas living at US zoos/aquariums and a captive facility in Grand Cayman as part of a species recovery plan, an estimated total of 91 to 120 blue iguanas exist worldwide.

The report is a result of surveys conducted between December 2001 and June 2002 as part of the Blue Iguana Recovery Plan, a document detailing wide-ranging conservation measures of the blue iguana. The stated purpose of the plan is "to restore a wild population of the Grand Cayman blue iguana sufficient to remain viable in the long term." The new report concluded that without intervention and immediate preventative measures, the surviving wild population would be functionally extinct within the next five years.

The report further states, "Since 1993 the habitat occupied by Blue Iguanas (not including the managed population released by the Trust in the QE II Botanic Park) has shrunk from approximately 7.0 to 3.7 square kilometers, and within the remaining range the population has been reduced approximately five-fold. Many of the surviving iguanas are isolated, with only one location identified where breeding has occurred in the last two years."

Once in abundance, iguana populations throughout the Caribbean islands began to decline with the advance of colonization. The situation on Grand Cayman is compounded by rapidly expanding development on the small island. In the wake of encroaching civilization, pristine habitats were destroyed and replaced with residential and commercial development that continues today, leaving virtually no natural habitat for the iguana.

The few remaining blue iguanas are isolated in small habitat pockets. Uncontrolled feral cats kill most of the young iguanas, while some of the adult iguanas are killed by free-ranging domestic dogs or hit by cars while basking on new roadways as the human population expands throughout the island.

"In the long term, it is clear that the future of wild blue iguanas must now rest on managed populations in protected areas," says Burton. "Sufficient protected habitat does not currently exist to support the numbers of wild iguanas that are needed to secure the future of the species. Additional protected habitat for blue iguanas is therefore essential."

The short-term outlook for this rare iguana will likely depend on captive programs, both in Grand Cayman (*in situ*) and the US (*ex situ*). The ex situ program consists of the American Association of Zoos and Aquariums (AZA) Rock Iguana Species Survival Plan (SSP), which will attempt to maintain a stable and genetically diverse captive population of 225 iguanas as a hedge against extinction in the wild. In the absence of wild sub-populations, the SSP captive iguanas effectively will become the backup population. The success of this effort will require the commitment of more zoos to house and breed blue iguanas. New dedicated iguana management facilities in warm-climate southern zoos are desperately needed. Currently there are ten US zoos or aquariums housing a total of 24 blue iguanas (plus some eggs and new hatchlings) as part of the SSP. The US blue iguanas are housed at the Bermuda Aquarium; the National Zoo, Washington D.C.; Sedgwick County Zoo, Wichita, KS; Tulsa Zoo; Rosamond Gifford Zoo at Burnett Park, Syracuse, NY; St. Catherine's Island Wildlife Survival Center, Midway, GA (run by Wildlife Conservation Society of the Bronx Zoo); Gladys Porter Zoo, Brownsville, TX; Indianapolis Zoo; Central Florida Zoo, Sanford, FL; and the Shedd Aquarium, Chicago.

The *in situ* program will need to expand the scope of its operation in order to generate larger numbers of hatchling iguanas that can be head-started for future release. The National Trust for the Cayman Islands has managed a captive breeding facility on Grand Cayman since 1990, producing small numbers of iguanas that are being released annually in the adjacent Queen Elizabeth II Botanic Park. The released population has now grown to some 30 individuals, but the park's area is far too small to accommodate the recommended 1000-strong population size needed for long-term viability. With the Trust-run facility at maximum capacity, funds are urgently needed to construct new breeding and rearing enclosures. The Disney Wildlife Conservation Fund, through the IIF, recently awarded a grant that will support the purchase of construction materials, but additional funding is still needed to complete the project.

The IIF was established as a Texas non-profit 501 c(3) corporation in August 2001 in Fort Worth, Texas. Formed in response to the need for consistent funding for critical iguana conservation initiates, the IIF is composed of 12 board members representing the zoo, corporate and private sectors. The IIF seeks to ensure the survival of all iguana species through the promotion of a broad conservation agenda involving habitat protection, education, scientific research, and captive management.

Extinction of the blue iguana is not inevitable, but the conservation community and its many supporters worldwide must act decisively and quickly to prevent it. Additional donations (financial and supplies) are needed. Tax deductible donations can be made to the International Iguana Foundation (International Iguana Foundation, 1989 Colonial Parkway, Fort Worth, TX 76110; Attention: Rick Hudson). For more information regarding the Blue Iguana Recovery Plan, visit www.cyclura.com. Currently the website offers a number of blue iguana-related merchandise, including a special "Got the Blues" poster featuring art of the blue iguana, as well as mouse pads and blue iguana apparel. All profits from the sale of these items go directly to the Blue Iguana Recovery Program.

News & Comments

International Iguana Foundation Grants ❄ The International Iguana Foundation held their annual board meeting in New Orleans on 23 March 2003 and reviewed funding proposals. Grants totaling $67,230 (including $30,000 held over from 2002) were awarded for the following five iguana conservation projects:

Conservation and Management of the Anegada Iguana. $25,840. Glenn Gerber (Zoological Society of San Diego) and Kelly Bradley (Dallas Zoo). This project entails a monitored release of 32 iguanas on Anegada and Fallen Jerusalem, iguana population surveys on Anegada, a habitat suitability survey of Fallen Jerusalem, and maintenance and enhancement of the headstart facility. This release will allow a comparison of survival in two cohorts of juveniles released in environments both with feral mammals (Anegada) and without (Fallen Jerusalem).

Cyclura ricordi population and habitat surveys in the Pedernales province of the DR. $11,000. Sixto Inchaustegui (Grupo Jaragua). This project will conduct field surveys on one of the two known subpopulation of the Critically Endangered Ricord's iguana in the Jaragua - El Guano - Cabo Rojo - Pedernales region that includes Parque Nacional Jaragua. This area encompasses 46,900 hectares, much of it potential habitat for *C. ricordi*. This project was one of the primary recommendations from the *C. ricordi* Species Recovery Plan workshop conducted in November 2002. The other subpopulation, Isla Cabritos, is better known and is being surveyed using funding from the Indianapolis Zoo.

Reproduction and survival in St. Lucian iguanas: Breeding females, dispersing hatchlings and assessing the role of headstarting. $5,390. Anna TC Feistner (Durrell Wildlife Conservation Trust). This study will result in better understanding of location and dispersal of adult females and improved hatchling survival, and allow assessment of head-starting as a viable conservation tool for St Lucia iguanas. Funding will be used for local field assistants salary, expenses, and equipment.

Expansion of in situ captive facility for Cayman Blue Iguana, and start-up for local revenue measures to staff the facility sustainably. $10,000. Fred Burton (National Trust for the Cayman Islands). Funding also will help develop a web-based sustainable revenue stream to support the annual salary for the iguana facility manager. The IIF funded the first year salary for this position.

Jamaican Iguana Conservation and Recovery Program. $15,000 (held over from 2002). Peter Vogel (University of the West Indies). Funding for this ongoing field program will provide annual operating costs for the recovery efforts including protection of nest sites, monitoring of nesting females, collection of hatchlings for headstarting, and continued surveys and monitoring of the Hellshire Hills.

In ranking grants for funding the IIF gives preference to projects that are components of approved Species Recovery Plans, are included in the ISG's Conservation Action Plan for West Indian Iguanas or are ISG endorsed, projects that directly contribute to the survival of endangered iguanas and their habitats, and those that are part of established conservation programs.

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Herpetofauna of Anguilla ❄ The Reptiles and Amphibians of Anguilla, British West Indies, by Karim Hodge, Ellen Censky, and Robert Powell has just been published. This book will be available from Bibliomania (www.herplit.com) in the near future. ALL proceeds from copies purchased now, directly from Bob Powell, will go to the Anguilla National Trust. The book has 72 pages and about 100 color photographs and illustrations.

To order a copy now, please send a check made out to the Anguilla National Trust for $17 (includes $2 for S/H) to Robert Powell at the address below.

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Herpetofauna of Guadeloupe ✲ A new book entitled "Histoire Naturelle des Amphibiens et Reptiles Terrestres de L'Archipel Guadeloupéen. Guadeloupe, Saint-Martin, Saint-Barthélemy" by Michel Breuil was recently published by the Muséum National D'Histoire Naturelle in Paris. It is part of the museum series: Collection Patrimoines Naturels, volume 54. Order details at: http://www.mnhn.fr/publication/order.html

The first chapter deals with historical geology in connection with speciation events and with the islands' habitats. The second is a presentation of observations made by early chroniclers and naturalist travellers from the Paris Muséum who collected herpetofauna. The third chapter is an analysis of the herpetofauna from both historical and biogeographical points of view.

Six anuran, five chelonian, 21 lizard (including four extinct), and seven snake species are considered. The presentation of each species begins with a systematic account, and then it is described with numerous unpublished color photographs, maps, and line drawings. Detailed information on habitat, biology-ecology, reproduction, and sometimes protection needs and regression factors are given.

2003 ISG Meeting

This year's ISG Annual Meeting will be held in the Turks and Caicos Islands. The meeting will be 21-23 November, including a one-day field trip to Little Water Cay to observe *Cyclura carinata carinata*. A Conservation Management Plan Workshop for *C. c. carinata* will follow on 24-25 November.

ISG Merchandise ✲ T-shirts desgined by Iguana Specialist Group members are available in all sizes for purchase. Printing of the shirts was the generous donation of Allen Repashy of Southswell ScreenArts. The t-shirt above was designed by Jeff Lemm and features sparing male Cuban iguanas. The t-shirt below depicts John Bendon's Andros iguana. Both shirts are ash-gray in color and cost $15 ($12 goes to support ISG activities). To place an order, please send checks made out to the International Iguana Foundation to Jeff Lemm, San Diego Zoo, PO BOX 120551, San Diego, CA 92112.

Mouse pads and posters benefitting the Grand Cayman Blue Iguana Recovery Program are available for purchase online.
Visit http://www.BlueIguana.ky/shop2.html

Taxon Reports

Allen Cays iguana (*Cyclura cychlura inornata*)

May 2002

For only the second year in the past 22 of our long-term study, we censused in May instead of March. This allowed us to paint identification numbers on the adult females and precluded the need to handle females during our mid-June to mid-July nesting season trip.

Unlike the cold temperatures we experienced in May 2001, the weather was hot and perfect for the first half of this year's work. In fact, we captured 159 iguanas on Leaf Cay in the first 6 hours on the island! However, the last half of our trip was mostly overcast, often accompanied by drizzle or even heavy rain. Nevertheless, we shattered the previous record (427) by capturing 499 iguanas (Table 1). We also observed one copulation on Leaf Cay (ca. 3 PM; 20 May) and one on U Cay (ca. 9 AM; 18 May). Both occurred on the large beach of the respective islands, and lasted less than one minute.

Tail breaks frequencies in our large sample were quite low: Leaf Cay females, 10.4%; Leaf Cay males, 7.7%; U Cay females, 8.1%; U Cay males, 8.0%. Sex ratios were not significantly different from unity, with 173 females and 155 males captured on Leaf Cay, 63 females and 74 males captured on U Cay, and 4 females and 2 males captured on Allen Cay.

This year we recorded the precise capture location of nearly every iguana we captured. The most striking aspect of these data was that on Leaf Cay at least 154 of 350 total captures (44%) were made on the big west beach (site of most tourist activity), an area comprising only about 2% of the island. Clearly, feeding activity on this beach is drawing most of the island's adult and subadult iguanas there (see below).

During this May trip, we also implanted an additional 26 iguanas with PIT tags, and have now PIT-tagged a total of 440 lizards (Table 2). We had expected to implant more tags, but since we caught so many iguanas, we did not have sufficient time to do so. We continue to maintain the position that a combination of toe clips and PIT tags is the most reliable and least intrusive method for marking these iguanas, although tagging is expensive. We plan to make a major effort in 2003 to PIT tag as many additional iguanas as possible. Finally, with duct tape we attached radiotransmitters to the top of the base of the tail of 15 large female iguanas captured on the big west beach of Leaf Cay in order to relocate them in June.

June-July 2002

From 15 June to 13 July former students Kirsten Hines and Jen Valiulis and I again camped on Leaf Cay in order to study nesting behavior of the Allen's Cays iguana. It was our subjective sense that our June-July time was cooler this year than last year; we will eventually retrieve our temperature loggers from the field to quantify any real differences. Interestingly, precisely the same amount of rain fell during our month in 2001 and in 2002: 2.42" (6.1 cm). However, from comments made by boaters, much more rain fell in late May and early June (before our arrival) in 2002 than in 2001.

Females had already begun digging nest burrows on U Cay by our arrival on 16 June, but did not begin digging on Leaf Cay until 17 June. The first actual nest was constructed on U Cay on 18 June (1 day later than in 2001) and on Leaf Cay on 24 June (3 days later than in 2001). Nesting continued on U Cay until 10 July (mean date = 26 June, the same as in 2001), and on Leaf Cay until at least 12 July (mean date = 4 July, one day earlier than in 2001). The Leaf Cay female that we saw copulating in May finished her nest on 24 June, 35 days later. In addition, we are certain that a small number of additional females nested on Leaf Cay after our departure, because we had observed them excavating preliminary burrows and defending those sites before we left.

By our arrival in June, eight of the 15 transmitters we had attached in May had fallen off. However, the others remained attached long enough for us locate females and follow their movements. Of these seven iguanas, only one apparently skipped reproduction this year and remained on or near the big west beach the entire month. The other six migrated to the interior of the island (one) or clear across the island (five). Five of these were known to nest, and the other apparently nested (although we did not find the nest). Clearly, females migrate considerable distances across the island to nest. In addition, we found that although some females returned to precisely the same sites to nest this year as they did last year, some were quite distant. For example, one female last year nested along the coast on the eastern slope of the middle of the eastern sandy

	U CAY					LEAF CAY				
	Total			Cumulative		Total			Cumulative	
Year	Captures	Recaps	% Recaps	# marked	# Recaps	Captures	Recaps	% Recaps	# marked	# Recaps
1980	30	0	0	30	0	14	0	0	14	0
1982	43	9	21	64	9	50	3	6	61	3
1983	48	25	52	87	34	51	26	51	86	29
1986	75	37	49	125	71	79	19	24	146	48
1988	111	58	52	178	129	109	59	54	196	107
1990	113	83	74	208	212	136	81	60	251	188
1992	124	89	72	243	301	148	102	69	297	290
1993	34	33	97	244	334	94	73	78	316	363
1994	150	94	63	300	428	204	110	54	410	473
1995	123	106	86	317	534	150	125	83	435	598
1996	113	86	76	344	620	177	126	71	486	724
1998	95	79	83	360	699	205	150	73	541	874
2000	169	124	73	405	823	254	175	69	620	1049
2001a	140	110	79	435	933	284	220	77	679	1274
2001b	40	34	--	441	967	209	89	--	799	1363
2002c	143	118	83	460	1085	350	266	76	880	1629
2002d	37	34	--	463	1118	147	72	--	945	1701

Table 1 above. Recapture information by year for Allen Cays iguanas. Total number of captures for U Cay is 1581 (463 + 1118) lizards, and 2646 (945 + 1701) for Leaf Cay. All trips for 1980 through 2000 were in mid-March. Trips in 2001 and 2002 were in mid-May and mid-June to mid-July. a. Excludes one additional capture on Allen Cay and two captures on Flat Rock Reef Cay; b. Excludes six additional captures (including one recapture) on Allen Cay; c. Excludes six additional captures (including three recaptures) on Allen Cay; d. Excludes one additional capture (a recapture) on Allen Cay.

Table 2 below. Tally of pit tags deployed and their success rates for Allen Cays iguanas. True Tag Failures (tags are palpable under skin, but no signal), and Other Tag Failures (tags not palpable and no signal). Data for 2001 and 2002 are for May captures only. a. Excludes pit tags placed in three Allen Cays iguanas.

	U CAY					LEAF CAY				
Year	# Newly Tagged	Tagged to Date	Tagged Recaps	True Tag Failures	Other Tag Failures	# Newly Tagged	Tagged to Date	Tagged Recaps	True Tag Failures	Other Tag Failures
1993	5	5	0	--	--	11	11	0	--	--
1994	13	18	3	0	0	3	14	5	0	0
1995	52	70	10	0	0	19	33	8	0	0
1996	56	126	36	0	0	56	89	19	0	1
1998	0	126	57	0	3	77	166	49	1	2
2000	29	155	74	0	1	55	221	80	0	2
2001	24	179	75	0	0	14	235	93	1	2
2002a	6	185	65	0	0	20	255	65	2	0

ridge of Leaf Cay (in a very open area only a few meters from the high-tide line), and this year nested in the interior of the island (in an opening surrounded by tall thatch palms).

We excavated a total of 39 nests with attending females (37 by known females and two uncertain). Eggs were counted, measured and weighed, and all clutches were returned to their nest chambers and the burrow refilled with soil in the same configuration as when initially found. When we left each processed nest, the attending female immediately returned to the site and resumed defense. Miniature temperature data loggers were placed among the eggs of 15 nests to monitor incubation temperatures. We plan to return to the cays in October to check on egg survivorship in the marked nests.

Nest burrows averaged 1.59 meters in total length from entrance to end of egg chamber (only one cm shorter than last year on average!) and the depth to the bottom of egg chamber averaged 28.0 cm (0.5 cm deeper than in 2001). Like last year, the orientation of the initial opening of nest burrows was random, and burrows were not associated with a particular vegetation type. Mean percent canopy cover from a densiometer placed on the ground directly above the egg clutch averaged 22.2%, only 0.3% higher than last year. Nest depth was inversely related to densiometer readings (i.e., canopy cover) in 2001, suggesting that females may adjust burrow depth to achieve preferred temperatures therein (i.e., shadier sites require shallower nests). However, that relationship was not statistically significant this year, apparently because several females this year nested under sea oats, which provide high values of shade, but in reality are much hotter sites than those shaded by overhead bushes. The temperature loggers we placed in the 15 nests should

allow us to further examine these thermal relationships this fall.

Like last year, females defended nests vigorously, chasing away all other iguanas (even large males) from an area of at least eight meters diameter around the nest. Nest defense continued until the time we left the islands (i.e., at least three weeks for many females), demonstrating that nest defense is very protracted. Distances between the closest nests (both years combined) were 5.3, 6.1, 6.9, 6.9, 7.2, 7.2, 7.6, and 7.6 m. Adjacent females at these closest nests were frequently involved in aggressive encounters midway between their nests.

Nesting females this year ranged from 27.0 cm to 38.9 cm SVL (mean 31.6), compared to 26.5 cm to 38.9 cm SVL (mean 32.5) last year. Six of 37 nesting females measured less than 29 cm SVL, compared to only three of 43 females in 2001. The three youngest nesting females with good age-history records were 13.8, 13.8, and 13.8 years posthatching, compared to 13.8, 14.8 and 14.8 years last year. Our data suggest that sexual maturity in females is reached between 13 and 15 years, and at a SVL of 26 cm and body mass of 750 grams. Small adult females do not nest every year, whereas large females typically nest annually. On average, our data suggest that across all females only about a third reproduce in a given year. Since a typical clutch accounts for about 16.5% of a female's body mass, it apparently takes smaller females a longer time to recoup the energy they deposit in a clutch of eggs.

Clutch size averaged 4.4 eggs (range 1-8) in 2002, compared to 4.8 eggs (range 2-9) in 2001, although the difference is not statistically significant. Egg length and egg mass were not significantly different from those in 2001 (overall EL = 66.0 mm; EM = 49.4 g; n = 326); however, egg width was significantly larger in 2002 (mean = 36.0) than in 2001 (34.9 mm), though only by about 1 mm. As last year, larger females laid bigger clutches of larger eggs in longer burrows and earlier in the season than smaller females. However, smaller females laid longer eggs than larger females (though the eggs were narrower and had less mass).

We also continued our mark and recapture program on each island, capturing 137 iguanas on Leaf Cay that were not among the 350 others captured in May 2002. Very few subadult or adult iguanas avoided capture on Leaf Cay this year. This total (487) suggests that the population on Leaf Cay must be between 500 and 600 (excluding young of the year), slightly higher than our previous estimates. We also captured 36 more iguanas on U Cay in addition to the 143 captured in May, and these numbers do not alter our earlier estimate of about 300 iguanas (excluding young of the year) on U Cay. Between both trips this year we captured a total of 678 iguanas in the Allen Cays; that is, perhaps 70% of all Allen Cays iguanas in existence. Censuses of iguana populations this complete are very rare. Including all of this year's field work, we have made a total of 1581 captures on U Cay and 2646 on Leaf Cay (an amazing overall total of 4227, not counting captures on Allen's Cay or Flat Rock Reef Cay) since the study began in 1980.

We were also able to survey Allen's Cay during both May and June, capturing seven adult iguanas (four males, three females). We saw no juveniles this year. We still estimate the population on Allen's Cay to be at least 11 (distributed from the northern to southern ends of the island), but surely not much higher than that. We did find a couple of sinkholes with soil accumulations that may allow successful incubation in some years, but they were soggy wet this year due to the late May rains (and hence unsuitable for nesting this year).

The most surprising finding this year was the capture on Allen's Cay of a large male iguana originally marked on Leaf Cay in 1986, recaptured again in 1988, 1990, 1992, 1993, and 1994, and never seen again until now. We have never before had any evidence of inter-island movement in these iguanas, so the question remains as to whether human transport was involved in this case. The fact that this iguana was only 35.8 cm SVL when last seen in 1994, and is now 56.0 cm SVL (larger than any male we have ever captured on Leaf Cay by 10 cm), demonstrates that it is the environment on Allen's Cay that produces the gigantism there (i.e., it is not genetically based). Our favored hypothesis is that the gigantism is a result of the very low competition for food on Allen's Cay. This is supported by the rapid growth and large size of the Leaf Cay iguanas introduced to Alligator Cay in the Exumas Land and Sea Park, and studied by Chuck Knapp.

Scores of dead Audubon's shearwaters were again found on Allen's Cay this year, including some freshly killed (i.e., less than a day old, and not at all rotten). The very precise and complete removal of all the breast muscles now makes it clear to us that raptors (rather than iguanas) must be involved in this depredation. Osprey and barn owls regularly roost on the

island and were frequently seen this year, and represent the likely cause of the many shearwater deaths. In June we also chased a large iguana deep into its retreat, and as it pulled farther back into the rocky tunnel, a huge, nearly fledged shearwater (standing height perhaps 10") pushed its way past the iguana unharmed. It thus seems likely that these iguanas are not active bird predators, but rather opportunistic scavengers or perhaps predators of very young birds.

We again found numerous carcasses of iguanas on both islands (U Cay = six in May, two in June-July; Leaf Cay = six in May and 12 in June-July), although cause of death was not obvious for any of them. All carcasses and/or skeletal remains were salvaged and given to Sandra Buckner for archival purposes. We continue to be distressed about the number of carcasses we are finding. Most troublesome was the discovery of the bloated carcasses of two huge Leaf Cay males (one on the big west beach, and one on the rocks to the south of the beach), both of which seemed otherwise in good shape. One had even been caught in May 2002 and the other in May 2001, and both were perfectly healthy then. Unfortunately they were too rotten to necropsy.

We believe that the number of large males on Leaf Cay is not only unnaturally low, but also declining. Although U Cay is much smaller than Leaf Cay (and much more rocky, and hence less productive), on the north beach on U Cay we captured 23 to 25 large males (i.e., here defined as over 40 cm SVL) in the years 2000-2002 (representing 12.8 to 14.8% of all captures). A decade ago, in 1990 and 1992, large males also represented 12.4 to 14.5% of all captures on U Cay. In 1990 and 1992 on Leaf Cay, we captured only 15 large males (10.1 to 11.0% of all captures). However, in March of 2000, we captured 14 large males on Leaf Cay (only 5.5% of captures!). In 2001 (with very thorough censusing, and May-July data combined) we captured only 11 large males (2.2% of the total sample), and in 2002 we captured only 10 (2.0% of the total sample). These numbers suggest to us that the number of large males on Leaf Cay may be far below what would be expected based on island size, and that those that remain may be experiencing unusually high mortality.

The problem may be related to the fact that nearly all large males on Leaf Cay are located near the feeding beaches. For example, in 2002, seven of the ten large captured males were on the big west beach, two were captured on the adjacent beach near the house, and one was captured just over the ridge from that beach. These numbers do not include the two large dead males also found on and near the big beach. This concentration of large males on Leaf Cay at the feeding beaches no doubt intensifies aggressive behavior among males, but may also put them at the highest risk of consuming indigestible or toxic items offered by tourists, since these males often are the first to beg for food.

At some point, we need to address the issue of feeding iguanas on these cays. It would be our recommendation that feeding still be allowed on Leaf Cay (but that a small kiosk be built on the beach on which we could post the natural history information we have collected along with clear guidelines about appropriate foods to offer). Furthermore, we would recommend that feeding be completely banned on U Cay, and that a second kiosk be added with the same information, but directing tourists to Leaf Cay for feeding. These kiosks could also strongly suggest that since the islands are private, visitors should restrict their activities to the beaches, and that foot traffic on sandy areas above high tide line during late June to September could result in the trampling of nests.

<u>October 2002</u>

Kirsten Hines (Florida International University; Earlham College '97), and I spent 2-6 October in the Allen Cays excavating 39 iguana nests on Leaf and U Cay that had been located and mapped in June and July 2001, as well as seven others located during this trip by their tell-tale hatchling emergence hole or by checking sites with nesting burrows that were still active on 13 July when we finished our summer field stay.

Although all hatchlings had emerged from their nests by the time we arrived on 18 October in 2001, our timing was perfect this year as we encountered 37 live hatchlings still in their nests, not having completed their exit tunnels to the surface. Nests excavated the first week of October 2002 that contained live hatchlings (i.e., not yet emerged) had been completed 85, 86, 88 (two nests), or 89 (two nests) days earlier. Four nests under construction on Leaf Cay when we left on 13 July had hatched by our return in October after maximum incubation times (i.e., since 13 July) of 82, 83, 84, and 84 days; the latter three nests contained live hatchlings (the last in the act of hatching), but hatchlings had already emerged from the first. Only

one nest (in a very shady location on Leaf Cay) was unhatched on 2 October, 85 days after it was completed. Hatchlings had emerged from most nests by our arrival on 1 October, the shortest intervals since nest construction being 84, 85, 87, 88, and 89 days. Hatchlings had emerged from every successful nest (n = 19) older than 89 days. These data suggest that incubation must require about 80 to 85 days, with emergence occurring within just a few days.

Hatchlings found in nests (n = 37) averaged 9.46 cm snout-vent length (range 8.8 to 9.9 cm), 14.1 cm tail length (range 12.7 to 15.5 cm), and 34.7 g body mass (range 28 to 42.9 g), and did not differ significantly in size between islands. Adults showed no interest in these hatchlings as the latter were released (i.e., there was no evidence of cannibalism), even when hatchlings ran and stood in the shade of the head of large males.

Digital temperature loggers placed among the eggs of 13 nests (six on U Cay and seven on Leaf Cay) immediately after nesting in June-July recorded temperatures every five minutes until October. Incubation temperatures for the 85 days following deployment of the loggers ranged from 30.59°C to 32.72°C, and averaged 31.10°C for U Cay nests and 31.72°C for Leaf Cay nests (overall mean, 31.43°C). Given the variety of nesting soils, canopy cover, exposure to winds, and nest depths, these temperatures are amazingly uniform.

We measured soil moisture in 23 nests on Leaf Cay and 15 nests on U Cay. Nest soils were significantly wetter (by a factor of two) on U Cay than Leaf Cay. The driest nests were on the eastern (windward) sandy ridge on Leaf Cay, and the wettest were from the eastern and western edges of the sandy isthmus on U Cay. Initial analysis suggests that some nests may fail due to excess moisture late in incubation. A heavy rain event occurring near or at the time of hatching may occlude the soil, retarding the diffusion of oxygen into the next cavity. The high metabolic demands of late embryos and/or neonates (especially in large clutches) may result in their suffocation under these conditions. The offspring in two large clutches (each of eight eggs) in two of the five wettest nests on U Cay all died in the nests near (i.e., full term in the egg), at (i.e., as they pipped their eggs), or immediately following hatching. Our temperature loggers indicate that a major rain event occurred on 6 September (i.e., nest temperature dropped 2°C on that day). This soil moisture difference may explain why overall nest success is lower on U Cay than Leaf Cay (see below).

As for last year, nest survivorship was quite high, ranging from 0% to100%. Of 107 total eggs deposited on Leaf Cay in 2002, 91 (85.1%) hatched and emerged successfully, compared to 109 of 134 eggs (81.3%) in 2001. Of 71 eggs deposited on U Cay in 2002, only 37 (52.1%) were successful, compared to 49 of 68 (72.1%) in 2001. Our working hypothesis is that because the only nesting area on U Cay is so close to the water table, the soils there remain wet enough that a major rain event late in incubation can fully saturate the soils and suffocate the eggs and/or hatchlings. Although we are still analyzing our data, we have so far found no other correlates of nest survivorship (e.g., nest date, female size or age, egg size, nest depth, nest burrow length, or nest shadiness).

In 2002, mortality occurred by rupture by the nesting female (2 of 178 eggs; 1.1%), because the eggs laid were flaccid (i.e., eggs with nearly typical shell dimensions but with much reduced contents; 6.7%) and died immediately, during early development (apparently from desiccation; 3.4%), during mid to late development (again apparently from desiccation; 5.1%), were predated by insects or crabs during development (0.6%), as full-term embryos still in the egg (6.2%), during pipping of the egg (2.25%), as hatchlings in the nest (2.8%), or because eggs were completely removed from their nests (presumably by crabs; 0.6%). Respective losses in 2001 were from rupture (5 of 202 eggs; 2.5%), flaccid (4%), during early development (5.0%), during mid to late development (3.5%), due to predation (1.5%), as full-term embryos (2.0%), at pipping (1.0%), as hatchlings in the nest (0.5%) or by complete removal (2.0%).

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Andros iguana (*Cyclura cychlura cychlura*) and Exuma Islands iguana (*C.c. figginsi*)

Exumas Report (19 - 29 May 2002)

I spent 10 days in the Exumas with students from a consortium of Chicago area colleges. This is an annual class focusing on the natural history of the Bahamas. Students have been helping me collect data over the past four years for the Shedd Aquarium's long-term monitoring program of *Cyclura cychlura figginsi* populations in the central Exumas. Captain Lou Roth, of the R/V *Coral Reef II*, and I were able to visit Alligator Cay in the Exuma Cays Land and Sea Park (ECLSP) for a day. The vegetation looked completely burned. I have never seen it look so unhealthy. Almost the entire understory was gone and most of the sea grape was dead. I attribute it to Hurricane Michelle, which brushed the area in October 2001. The iguanas looked noticeably thinner than in previous years but were numerous. Hog bush (*Rhachicallis americana*) leaves and seven-year apple (*Casasia clusiifolia*) seeds were the only plants identified in 10 scat samples. None of the large adult founders were seen but only 1.5 hours were spent on the island.

Lou Roth and I then visited Pasture Cay in the Exuma Cays Land and Sea Park on 20 and 28 May. The understory vegetation was noticeably denuded but not as dramatic as Alligator Cay. We did notice stripped bark from narrow leaf blolly (*Guapira discolor*) tree branches. The stripped sections were at the terminal ends of thin branches and unlikely caused by iguanas but probably rats. Of the 16 original iguanas translocated in February, six were recaptured and three were observed (#1, 15, and 16). Two male-female pairs (5/9 and 10/12) were observed in segregated areas of the cay. The observed and captured iguanas appeared healthy but four were thinner than their pre-translocation body mass (Table 1). Three males (#8, 12, and 14) had the largest and most conspicuous femoral pore secretions that I have ever recorded (10 – 15mm).

I intend to initiate a simultaneous population study on the rats and iguanas of Pasture Cay. I hope to begin in 2003 but may have to start in 2004 because of my doctorate work on Andros.

It rained for much of our brief time on Bitter Guana and Gaulin Cays so our captures were low for the year. We failed to catch an iguana in the few hours of drizzle while on Bitter Guana during the morning of 21 May 2002. Ten people spent three hours on island and we observed only one iguana. We did see at least four goats on the island. A dead goat was found and photographed along the back trail of the north beach.

We spent 21 and 29 May 2002 on Gaulin Cay. A total of 23 iguanas were caught including eight recaptures. Two of the recaptures were previously caught in 1998 and 2000. A pair of iguanas was seen mating on 21 May. All age classes were noticed and the iguanas appeared healthy. Goat droppings and tracks were again observed on the island but not goats.

Andros Report (April – June, August – October 2002)

The 2002 field season began with the Shedd Aquarium's annual research excursion aboard the R/V *Coral Reef II*. We again had participants from around the country and managed to get much accomplished. The focus of the trip was to identify areas with high enough iguana densities for meaningful radio telemetry studies. On 31 March we began the study at a new location: Sandy Cay in South Bight. We set up base camp on the northwest side of the cay and worked the island for six hours, capturing eight iguanas, and observing another three. The area is ideal for radio telemetry studies because it has all four main vegetation types (pine woodland, broadleaf forest, broadleaf scrub, and mangrove/ hogbush flats) used in this study.

On 1 April we went to Guana Cay, north of Alcorine Cay in South Bight, and captured four iguanas before it poured rain at 1230 hrs. We went to Dissertation Point, Mangrove Cay on 2 April. The north portion of the site took heavy hurricane damage in the interior. I was concerned by the lack of iguana sightings (only five). We saw evidence of people visiting the island. Trails were cut into the interior palm forest of the middle section of the site. Also, one large iguana was captured with what appeared to be a machete cut on its back right leg and several clean lacerations on its ventral side. The cuts were too clean and serious to be from another iguana and I suspect that locals tried to

Iguana	Sex	Feb 2002 BM (kg)	May 2002 BM (kg)	Difference (kg)
5	M	7.25	7.94	0.69
8	M	7.8	7.08	-0.72
9	F	3.63	3.49	-0.14
10	F	3.59	3.63	0.04
12	M	7.24	6.37	-0.87
14	M	7.31	6.69	-0.62

Table 1. Body mass (BM) comparisons of recaptured iguanas from Pasture Cay, ECLSP.

catch the animal and hacked at it before it escaped down a limestone hole. Although people are visiting the site and animals are probably taken occasionally, I did observe more animals as I returned to the area. The early trip date may have played a factor in the lack of initial sightings.

Iguanas were captured from Grassy Creek to Middle Bight. We stopped at a small island in Grassy Creek known locally as iguana cay (~1 ha) and captured four iguanas and saw an additional five. This cay had a high-density of heron nests, the most I have ever witnessed. It appeared as if there was a nest every 15 meters. All the iguanas had tail breaks and missing digits, perhaps from attempted predation by herons. The northern most capture site is called Cabin Dock (Alcorine Cay) on topographic maps and is a small area (~1 ha) completely surrounded by inundated mangrove flats. Six iguanas were observed including adults and juveniles; two adults were captured.

Radio transmitters were initially attached to the animals on Sandy Cay and Alcorine Cay, across the bight. Radio transmitters were sewn into vests and attached across the chest with straps crisscrossing between the front legs. Unfortunately, all the vests fell off within a week. The transmitters were recovered and, for lack of a better alternative, duct taped to the base of tails. The tape lasted from four to 30 days but a new method of attaching the transmitters to the dorsal crest using a method similar to beading the animals will be used next year. Some interesting data emerged from the fragmented telemetry study and will be used as a base for hypothesis testing in 2003. It appears that males and females form monogamous pair bonds during the breeding season and even share the same retreats. Males are never far from females during April and will follow the female throughout her range. Occasionally a rival male will appear and is immediately chased off, only to return continually throughout the breeding season.

Although I missed neonates emerging from the nests this year, I managed to capture two recent hatchlings (SVL: 9.9 and 10 cm; BM: 45 and 50 g, respectively) in September and follow their movements for a week. Each hatchling dispersed immediately from the capture location and crossed tidal cuts (one 15 m across, the other 150 m across). Dispersal distance was at least one km until I lost signals. Hatchlings must be monitored daily in 2003 to prevent losing the radio signal.

Seven female iguanas were observed guarding nests. All nests were constructed in termite (*Nasutitermes rippertii*) mounds. Four of the nests did not contain eggs but all females defended and reburied nest openings continuously for up to three months. Of the nests that contained eggs, one had eggs that disappeared and the other two had 100% hatch rates. I suspect that the eggs fell prey to land crabs (*Cardisoma* sp.) because of observations I made on a nest where eggs disappeared after I checked and recorded four eggs two days earlier. In this instance, an egg broke during initial excavation and yolk spilled in the entrance to the egg chamber of the mound. Determined to discover what could have caused the disappearance, I went back to set a trap using a chicken egg and spilled egg yolk spilled into the nest entrance. I covered the entrance and waited behind a tree. A land crab emerged after 10 minutes and began digging at the mound entrance. It took a piece of wood saturated with yolk back down its burrow. I suspect crabs may take eggs during the night and females rebury the entrances the next morning, leaving no trace of the plunder.

Measurements were taken from used and non-used mounds for comparison studies. Mound height and circumference were recorded. Canopy cover above the mound was measured using a spherical densiometer. Loose substrate depth at the base of the mound and 15 cm away was averaged to calculate skirt depth around the mound. In active nests, entrance orientation was determined using a handheld compass and digital data loggers were placed with the clutch in the mound while temperatures were recorded four times per day.

A female Andros iguana guards her nest within a termite mound.

Chuck Knapp explains iguana biology to Andros school children.

Data loggers were also placed above the mounds to record ambient temperatures. Tree and shrub species around the mound were also recorded. Sample sizes for mound demographics and clutch size are too small for meaningful statistical comparisons at this time so data from 2001 through 2003 will be combined in my final analyses. In the meantime, I have included a table of the 2001 and 2002 data of nests with eggs for comparisons (Table 2). The nest used in 2001 was not used by a female iguana in 2002.

Transects for distance sampling were walked from August to October. Transects were stratified by four main habitat types (pine woodland, broadleaf forest, broadleaf scrub, and mangrove/ hog bush flats) with randomized starting points. Approximately nine km have been walked to date with a goal of 80 km total. Nineteen iguanas have been observed during the transects and broadleaf scrub areas seem initially to harbor the highest iguana densities.

Maria Morera, an anthropologist from the University of Florida, and I conducted 18 in-depth interviews with local people. Fifteen of the interviews were conducted on South Andros but additional surveys will focus on Mangrove Cay and North Andros. The interviews were conducted in an attempt to quantify hunting pressure, record historic and contemporary iguana uses, and gauge perceptions about conservation initiatives such as national parks. Insights were gained from these initial interviews and we suspect that hunting is not a large-scale commercial operation but still occurs on a subsistence level. Most people were receptive about national parks but emphasized the need for local input and the dangerous consequences of hurting livelihoods by closing areas to hunting and fishing.

Two hundred-forty visitor surveys were distributed to eight hotels across Andros. The surveys are meant to gauge visitor's perceptions of iguanas and national parks, and their willingness to pay for guided tours and park entrance fees. According to initial preliminary surveys, over 90% would be willing to pay entrance fees into national parks if the money goes toward protecting species and habitat. Ten dollars was the most quoted amount that visitors were willing to pay for a park entrance fee.

In order to raise awareness of the iguana on Andros, I have given a presentation at the South Andros high school using live iguanas as a teaching tool. The students were extremely receptive and many volunteered to assist me in the field. Three high school students assist me in the field regularly. Tiamo Resorts and I initiated a poster contest for the students of South Andros. Any student entering a "Protect the Andros Iguana" poster design received a tee shirt and the winner will receive $100. Time restraints prevented us from picking a winner this year but it will be completed in 2003 and I hope to make similar presentations in Mangrove Cay and North Andros schools.

I have funding to hire two field assistants in 2003. I have identified a person at FORFAR Field Station on North Andros that will make an excellent candidate and am in the process of identifying a Bahamian student that will be willing to work on the project. I anticipate a much smoother and productive field season next year because of the additional help and refined research methods.

I am fortunate to have so many people and organizations assist me and offer guidance during these studies. I thank Eric Carey and the Department of Agriculture, the Bahamas National Trust, C. Kenneth Dodd, Sandra Buckner, Lou Roth, Greg Graham, Maria Morera, Dwight "Butter" McKenzie, Ray Dean, Bradley Long, Andy Baer, Darrin Masters, Suzy Nelson, Sonja Tiegs, the Shedd Aquarium volunteers, and Tiamo Resorts of South Andros.

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	12-May-01 Linder Cay	9-May-02 Mangrove Cay	17-Jun-02 Mangrove Cay	18-Jun-02 Hog Cay
SVL (cm)	---	47.7	---	33.3
BM (kg)	---	4.45	---	1.16
Clutch size	15	7	9	4
Mean egg mass (g)	63.3 (60.0 - 70.0)	80.3 (75.0 - 85.0)	69.4 (65.0 - 70.0)	61.3 (60.0 - 65.0)
Mean egg length (mm)	70.2 (66.1 - 73.8)	76.3 (74.1 - 79.4)	67.9 (65.9 - 70.9)	76.9 (75.9 - 78.0)
Mean egg width (mm)	39 (35.6 - 41.9)	42.7 (38.5 - 44.1)	41.9 (40.1 - 43.1)	35.7 (35.5 - 35.9)
Mound height (cm)	50	35	40	23
Mound circumference (cm)	163	175	124	118
Mean skirt depth (cm)	8	7	8	6
Entrance orientation (°)	100	210	320	60
Canopy cover (%)	81	49	34	72
Mean incubation temperature (°C)	33.7 (28.4 - 36.4)	33.3 (27.5 - 37.4)	31.5 (28.6 - 34.2)	---
Mean ambient temp. (°C)	28.2 (17.3 - 38.1)	30.1 (22.4 - 38.1)	31.9 (23.9 - 48.2)	---

*Table 2. Female size and nesting parameters for the Andros iguana (*C. c. cychlura*). The two females that eluded capture had an estimated SVL and BM of at least 40 cm 3.0 kg, respectively.*

Cuban iguana (*Cyclura nubila nubila*)

Study of the use of the Cuban iguana in the Refugio de Fauna, Cayos of San Felipe, Cuba. *Translated/edited from Spanish by Jean-Pierre Montagne and ISG newsletter editiors (San Diego Zoo).*

In spite of being one of the largest lizards of Cuba, the Cuban iguana has been little studied. Only six aspects of their biology have been partially evaluated in three studies (Table 1). Some fishing communities harvest this species for the consumption of its meat and fat. Harvesting has intensified on the iguana populations in the Refugio de Fauna Cayos de San Felipe by the fishermen of Puerto de La Coloma. This area comprises four large cays and numerous smaller cays of red mangrove and sandy areas where the iguanas live. In 1999, seven years after the cays were declared Protected Areas, the capture of iguanas officially ceased. The objectives of this work were to evaluate this traditional harvesting, that until 1999, was exerted on the population of iguanas of these cays, and to determine the present distribution and abundance of the species.

In order to determine the distribution of the iguana on all the cays, continuous visits were made during 1999 and 2000. Density was estimated using classic transect surveys. Size, sex ratio (% of females), age ratio (% of nonadult), and habitat preference were also evaluated. The morphology, densities, and sex and age ratios were similar to those of other cays where human depredation does not occur (Tables 2 and 3). Habitat preferences varied depending on whether iguanas, feces, or burrows were counted (Table 4). Iguana burrows were further associated with particular species of plants and types of substrate (Table 5).

To study iguana consumption, interviews were conducted in 2000 with 522 adult settlers of Puerto de La Coloma and 30 fishermen who had consumed iguanas. Among the adult population of Coloma, 19.5% had consumed iguanas, but this percentage is slightly greater for male fishermen over the age of 39. The average number of

	Perera (1981)	González *et al.* (1991-92)	Berovides *et al.* (1999-2001)
Morphology	+	+	-
Food / Feeding	+	+	-
Abundance	+	+	+
Burrows	-	+	+
Habitat selection	-	-	+
Human impact	-	-	+

Table 1. Ecological investigations with Cuban iguana.

	STUDY AREAS			
	Cayo Largo	Cayo Rosario	Cayos V. Clara	Cayos San Felipe
SVL ± S.D. (cm)				
Males	40.5 ± 3.1	37.8 ± 2.7	30.2 ± 4.8	35.1 ± 4.5
Females	32.0 ± 1.6	31.3 ± 4.5	25.8 ± 4.0	34.3 ± 4.4
	N=30	N= 37	N= 21	N= 20
Iguanas/ha	4.4 - 25.0	6.5 - 12.8	3.8 - 27.3	12.1 - 26.1
	N= 42	N= 194	N= 18	N= 15

Table 2. Body length (SVL) and density in populations of Cuban iguana.

Cayo Juan Garcia (Seasonal)				
Period	Surveys	Density ± S.D.	SR	AR
Nov-Jan	3	13.0 ± 1.4	42.5	40.0
Feb-Apr	4	12.1 ± 2.8	45.1	29.5
May-Jul	2	16.2 ± 1.7	40.0	50.0

Three Cays (Spatial, July)				
Cays	Sample	Density	SR	AR
Juan García	1	13.8	37.5	42.8
	2	16.1	42.8	56.2
Sijú	1	13.8	37.6	46.7
	2	15.4	44.4	30.7
Coco	1	26.1	40.0	53.1
	2	20.0	36.3	45.0

Table 3. Density (iguanas/ha), sex ratio SR (% of females), and age ratio A (% non adult) for iguanas of Cayos de San Felipe.

		Iguanas		Burrows		Feces	
Habitats	%	%	PI	%	PI	%	PI
A	16.0	40.2	2.5+	30.0	1.7+	20.9	1.3+
B	18.6	32.6	1.17+	3.4	0.1-	15.5	0.80
C	56.8	30.3	0.3-	66.6	1.20	18.6	0.3-
D	8.6	7.9	0.90	-	-	45.0	5.2+
Chi^2 Test X^2		18.8 (P<0.001)		6.8 (P<0.01)		241.3 (P<0.001)	

Table 4. Habitat preference of Cuban iguana on Cayo Juan García. A=Sandy area with Rhynchospora*; B=Flooded area with* Batis maritima*; C=Dense scrub; D=Beach vegetation; PI=Preference index (+ / - / 0 positive/negative/ null association).*

Item	Random samples (%)	Burrows (%)	PI
Ernodea	36.2	31.0	0.8^{-}
Erythalis	1.0	2.1	2.1^{+}
Chrysobalanus	10.0	11.4	1.1^{+}
Grass	1.3	0.7	0.5^{-}
Rhynchospora	3.3	2.3	0.7^{-}
Thrinax-Metopium	1.1	1.0	0.9^{0}
Sand without Debris	7.6	24.0	3.2^{+}
Sand with Debris	39.4	27.3	0.7^{-}

Table 5. Plants and substrate preference near the burrows of Cuban iguana. PI=Preference index.

Questions	Answers	Majority
1. Actual status of iguana populations	Decline	71.4
2. Cause	Hunt	90.0
Harvests (iguanas/month/ship)		
Before 1990	6 - 10	45.0
	10 - 25	0.0
1990 - 1998	6 - 10	12.5
	10 - 25	50.0
4. Preference by iguana meat	YES	100.0
5. More preferred than chicken	YES	59.1

Table 6. Interviews with fishermen of La Coloma who consumed iguanas (N= 30).

iguanas harvested by boat per month was 6-10 before 1990. In 1990, a period of economic restrictions in Cuba began, and the number of iguanas harvested increased to 10-25 per boat per month, until 1999. In spite of these high extraction rates, the iguana was not extirpated from any cay or habitat. Given the short period (two years) between the cesation of harvesting (1999) and the present study (2001), the stability of the population cannot be explained by recruitment, considering the delayed sexual maturity of this species. Our hypothesis is that the population maintained its normal density levels in spite of the intense human depredation because of its metapopulation structure (each cay as a subpopulation). The area is divided in two large fishing zones, each with two large cays. One zone was fished by settlers from La Coloma, while the other zone was fished by settlers from other towns who did not consume iguanas. The popluation of iguanas in the second zone provided emigrants that maintained the stability of the first population which had high depredation.

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Fijian crested iguana (*Brachylophus vitiensis*)

The Fijian crested iguana is listed by the IUCN as Critically Endangered (IUCN, 2002). Because recent surveys have confirmed that only one viable population of this species remains, international support is required to assist in the maintenance of the Crested Iguana Sanctuary island of Yadua Taba. Yadua Taba was declared Fiji's first wildlife reserve in 1980.

The International Conservation Fund for the Fijian Crested Iguana (ICFFCI) was established in 2000 by a Memorandum of Agreement between the National Trust of Fiji Islands, and the two recognized centers for the captive breeding of the Fijian crested iguana: Kula Eco Park in Sigatoka, Fiji, and Taronga Zoo in Sydney, Australia. The need for this international conservation fund was perceived and its creation accomplished primarily by Carol Bach (Taronga Zoo) and Philip Felsted (Kula Eco Park). The objectives of the fund are to:

➢ Develop, through education and public awareness programs, a better understanding and appreciation of the Fijian crested iguana and its habitat.

➢ Assist in the conservation of existing wild Fijian crested iguana populations and their natural habitat.

➢ Create, manage, fund and maintain one or more new crested iguana sanctuaries in the Republic of Fiji.

In the three years since its creation, ICFFCI has organized and funded several projects. An endangered species education program was undertaken in Fiji that featured the crested iguana and was delivered in critical habitat areas. All parties to the agreement developed programs directed at schoolchildren, and successfully brought the crested iguana conservation message to many people via television, radio, magazine, and newspaper coverage within and outside Fiji. One of the spin-offs from this was the awareness that the program created among Fijian government officials, who became instrumental in negotiating and funding the lease for Yadua Taba, despite politically difficult times. Because the proceeds of the lease for Yadua Taba do not benefit the nearby villagers on Yadua (who are not the traditional owners), a goodwill payment was made to the village school, and a series of gifts was sent to the village in recognition of the important role it plays in supporting the sanctuary. The Yadua school children have had an annual educational fieldtrip and guided tour of the Yadua Taba Crested Iguana Sanctuary by the ranger (November 2001 & 2002). For many of these children it was their first visit to the

The island of Yadua Taba taken from Yadua island in 1979. Photo by John Gibbons.

Crested iguana from Yadua Taba. Photo by Peter Harlow.

sanctuary island and their first view of a crested iguana, despite the fact that the village is only 4 km away on the island of Yadua.

Conservation efforts continue to concentrate on the needs of the Crested Iguana Sanctuary on Yadua Taba. The sanctuary ranger Pita Biciloa, Fiji's only wildlife ranger, was brought to Sydney in November 2000 for a two-week training program with local National Parks and Wildlife Service staff and vegetation regeneration specialists. He was provided with uniforms and many items of field equipment (spotlights, binoculars, camping equipment etc). In a joint funding arrangement with the National Trust for Fiji, the fund paid for half of a new 28-foot sanctuary patrol boat and outboard motor.

Funding for all these projects came from a variety of sources. Special recognition should go to the major sponsors, especially Bradley Trevor Greive, John Binns (www.cyclura.com), Yamaha Motors of Australia, RandomBase Consulting and the Australian Society of Zoo Keepers (ASZK). Smaller individual public donations of cash, equipment, and supplies all helped significantly. The immense time and effort contributed by volunteers and the staff of all parties to this agreement are priceless. Much more work needs to be done to guarantee the future of the spectacular and unique Fijian crested iguana, including the setting up of new sanctuaries in the future.

Keep watching the web page {International Conservation Fund for the Fijian Crested Iguana (ICFFCI); www.icffci.com} for information and updates.

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Utila iguana (*Ctenosaura bakeri)*

Utila is the smallest of the principal Honduran Bay Islands (41 km^2). This relatively tiny body of land, however, supports a phenomenal reptilian diversity that includes three native species of iguanas (*Ctenosaura bakeri*, *C. similis*, and *Iguana iguana*); the only island so blessed anywhere in the world. The island also supports 12 other species of lizards, 11 snakes, a freshwater turtle (*Trachemys* sp.), and a crocodilian (*Crocodylus acutus*). The latter may already be extirpated, although locals suggest that one croc remains.

The Utila Research and Breeding Station was established through the efforts of ISG member Gunther Koehler in 1998 to help protect the remaining populations of *Ctenosaura bakeri* (Swamper or Utila iguana) that were threatened by hunting. The major goals of the facility were to establish a breeding program and create a local conservation ethic, primarily through public education.

During a visit in 2001, I noted that the efforts of the Iguana Station to promote conservation of *C. bakeri* had not been well received by Utilians. Iguana hunting had continued and I noticed some apparent resentment of what was being perceived as outside interference. During the last two years, however, an influx of migrant workers and an onslaught of development has had a positive effect on the receptiveness toward conservation ideals. Utilians have realized that the island was undergoing dramatic changes that would inevitably result in the loss of its unique character, which included its very own iguana.

Taking advantage of these changes, the Bay Island Conservation Agency (BICA), the other NGO on Utila, and the Conservation Project Utila Iguana (CPUI; a program developed by the Iguana Station) increased efforts to promote conservation. One of the major goals of this effort is to establish a mangrove sanctuary (habitat of *C. bakeri*) that incorporates an eco-trail originating in the proximity of the Iguana Station and leads through the mangrove swamp to Rock Harbor on the northern shore.

In March 2003, hosted by the Iguana Station, the International Iguana Society (IIS) held its conference on Utila. This provided me with an opportunity to revisit the island and evaluate progress of the Station's efforts. In stark contrast to my previous experience, the term 'Iguana People,' used by Utilians

to describe the researchers, had taken on an entirely new and positive meaning. The IIS contingent was welcomed and locals with whom they interacted were quite interested in learning about conservation and invariably expressed a distinct curiosity about their very own Swampers. The director of the Iguana Station and I were invited to broadcast a message on local TV inviting all Utilians to attend the IIS conference. Some residents responded, which added immeasurably to the success of the conference.

Presentations were scheduled each evening. Topics ranged from the natural history of *C. bakeri* to iguanas of the West Indies and the effects of alien species on natives. During the days, Station personnel had organized trips, hikes, and work activities of varying difficulty so everyone could participate. One task involved a boat trip through a small canal in the mangroves to the northern beaches used as nesting sites by *C. bakeri*. Teams of IIS and Station people cleared a substantial area of invasive vines that interfere with nest construction from a critical nesting beach.

In less public discussions with key CPUI and Station personnel, we were told that iguana hunting was in steep decline, suggesting that the years of effort were paying off. However, the benefits of that accomplishment might be short lived. During the last few years all but two parcels of beachfront real estate, including all of the prime nesting areas of *C. bakeri*, have been sold to developers. One of the remaining parcels is not suitable for nesting, but the other is located exactly where the proposed eco-trail would end at Rock Harbor. This was devastating news, particularly with the quick realization that no effort could ever remediate this loss. The topography precludes any alternate nesting sites; so once development begins, the currently healthy and stable populations of *C. bakeri* will decline quickly and dramatically.

The IIS and CPUI have agreed to collaborate in rallying efforts to secure that last parcel of beachfront property. The cost of the property is US $165,000. To date, the IIS has generated nearly $5,000, and a proposal for a land grant with a maximum potential of $85,000 has been submitted to IUCN Netherlands. Additionally, the plan seeks to establish a small outpost manned by Iguana Station personnel, who will aid in monitoring the property and who also will work with developers to select building sites that preserve as much undisturbed beach area as possible. The success of this effort will be based largely on the ability to instill an awareness of conservation needs in owners and developers before construction begins.

Despite the wonderfully rich biodiversity of Utila, the fate of the Swamper remains uncertain, as does that of the other flora and fauna. However, hope that the early conservation efforts pioneered by Gunther Koehler, continued today with the aid of volunteers and supported by organizations such as the IRCF and IIS, will have had a sufficiently positive impact on the people of Utila that they will support ongoing efforts emanating from the Station and ultimately will initiate and implement their own conservation programs.

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Personnel at the Station recently found a dead gravid C. bakeri *female. Four eggs were removed from the carcass and incubated at the Station. Two of the eggs were not viable and two hatched, with one hatchling dying shortly thereafter. The remaining hatchling, a female, survived, and upon further examination turned out to be a* C. bakeri x similis *hybrid. The healthy female was mated with a* C. bakeri *earlier this year, is now gravid, and has been placed in an isolated nesting cage to determine fertility. Photo by John Binns.*

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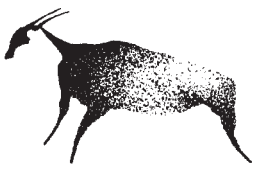

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