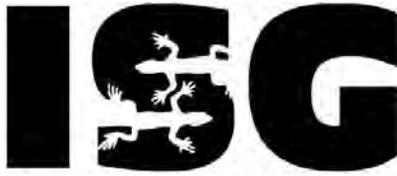


Iguana Specialist Group Newsletter

Volume 8 • Number 1 • Summer 2005



The Iguana Specialist Group prioritizes and facilitates conservation, science, and awareness programs that help ensure the survival of wild iguanas and their habitats.

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News & Comments

International Iguana Foundation Reaches Significant Milestone ✨ The February 2005 release of 16 Jamaican iguanas, *Cyclura collei*, brings to 100 the total number of iguanas released since 2003 with support and funding from the IIF. Twelve *C. collei* had been released previously in 2003 and 2004. Forty-eight Anegada iguanas, *C. pinguis*, were repatriated to the wild in October 2003 and 2004, and 24 Grand Cayman blue iguanas, *C. lewisi*, were released from December 2004 to January 2005. The pre-release health screening aspect of these projects was funded by a grant from the Morris Animal Foundation through the IIF.

Jamaican Iguanias Released in Hellshire ✨ On 26 February 2005 another group of headstarted Jamaican iguanas, *Cyclura collei*, was repatriated to their native habitat in the remote Hellshire Hills of southeastern coastal Jamaica. Sixteen (8.8) iguanas were released as part of a joint collaborative endeavor between the Hope Zoo, University of the West Indies (UWI), the International Iguana Foundation, and the Fort Worth Zoo. The adult-sized iguanas were released without radio transmitters and, based on previous survival rates, are considered to be at low risk. However the new iguana biologist working in Hellshire, Rick Van Veen, is in the field full-time now and is recording regular observations on some of the iguanas. To make recognition easier in the bush, each iguana is labeled with bright neon paint – pink for females, yellow for males – and tagged with colored bead tags in the dorsal neck crest. The males were released at randomly selected sites throughout the core iguana area in Hellshire in hopes of dispersing them to reduce aggressive encounters. Females are released at the two primary nest sites and allowed to disperse from there. Though imprinting on these natal nesting areas has not been documented, recognition of these sites may prove to be important when these females return to nest in the future. For the past three years previously released female iguanas arrived at the nest sites and



deposited eggs, a strong indication that they are successfully integrating with the wild breeding population.

The field research program is under the direction of Dr. Byron Wilson of UWI and the captive iguana headstarting program is managed at Kingston's Hope Zoo. A veterinary team from the Fort Worth Zoo provided medical support and conducted pre-release health screening exams on each iguana before it was cleared to go. This aspect of the program was funded by a grant from the Morris Animal Foundation.

This release was funded by the International Iguana Foundation and brings to 76 the number of Jamaican iguanas that have been released since 1996.

Anegada Iguanas Released ✨ Twenty-four (12.12) headstarted Anegada iguanas, *Cyclura pinguis*, were released on Anegada, British Virgin Islands (BVI), on 8 October 2004, bringing the total number to 48 in the past two years. The first iguanas (12.12) were released in October 2003 and based upon encouraging survivorship data (20 of 24, or 84%), a second release was conducted. The 2004 release used an identical strategy to that employed in 2003 except that the minimum size of released animals was reduced from 750g to 550g in an effort to determine the minimum size iguana that can coexist with feral cats. As in 2003, 12 iguanas with surgically implanted transmitters were released at each of two study sites, representing two distinct habitat types (coastal sandy scrub and interior limestone forest) located in the core iguana area. At more than five months post-release, 22 animals survive and are gaining weight (up to 260 g) and have established home areas within 400m of their respective release sites. Iguana movements and survival are being monitored through radio tracking by Kelly Bradley (Dallas Zoo) as part of a Masters program at the University of Texas at Arlington.

These releases are part of the Anegada Iguana Recovery Program that began in 1997 with the construction of a small headstart unit. This facility was expanded in 1998, and more than 120 iguanas have been headstarted here for eventual release. The recovery strategy seeks to boost the wild population of adult iguanas by offsetting high juvenile mortality due to cat predation. Other aspects of the program include habitat mapping, population monitoring, field research, nest site protection, collection of hatchlings for headstart, local education and public awareness,

and nutritional, genetic and veterinary research. Plans for a feral mammal control program are in the early stages of development. *Cyclura pinguis* has undergone a chronic population decline on Anegada since the 1960s with current estimates for the wild population at ~200. Ranked Critically Endangered by the IUCN Red List, this species is dependent on conservation intervention to ensure their survival.

The International Iguana Foundation (IIF) funded both the 2003 and 2004 releases, as well as other components of the field program. Working in conjunction with the BVI National Parks Trust this program has, since 1997, been managed cooperatively by staff from the Fort Worth, Dallas, and San Diego Zoos, and represents an excellent working example of a successful zoo partnership. Since 1998 this program has been supported with major grants by AZA's Conservation Endowment Fund, Zoological Society of San Diego, Morris Animal Foundation, Institute of Museum & Library Services, and the IUCN/SSC Sir Peter Scott Fund. Funding for specific projects was provided by the Bergen County Zoo, Chicago Zoological Society, Chicago Herp Society, Cleveland Metroparks Zoo, Dallas Zoo, Fort Worth Zoo, John Ball Zoo, Pittsburgh Zoo, Roger Williams Park Zoo, and the Wildlife Conservation Society.

Rick Hudson
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2005 Annual ISG Meeting

The annual Iguana Specialist Group meeting will be held 5-9 November on Andros island, Bahamas, and will include a Species Management Workshop for the Andros iguana. The IIF Board of Directors meeting will follow, beginning the afternoon of the 9th and continue through the 10th.

Sir Peter Scott Fund ✨ The first recipients of the Sir Peter Scott Fund for Conservation Action Grants were announced 11 November 2004 by IUCN-The World Conservation Union. The ebony forests of Mauritius, the Anegada iguana, and the Critically Endangered Przewalski's gazelle are all set to benefit from the first round of grants issued under the Sir Peter Scott Fund for Conservation Action, created by the IUCN Species Survival Commission (SSC).

The Sir Peter Scott Fund for Conservation Action provides small grants (up to US\$15,000) to support the activities of its members in their work to conserve threatened species around the globe. In many parts of the world, a small amount of well-directed money can have a significant impact.

In the inaugural round, three projects have been selected to receive grants, \$40,000 in total. David Brackett, Chair of the SSC congratulated the project leaders, saying "The selection committee was very impressed with the quality of the proposals submitted. They reflected the tremendous range of activity being undertaken by the more than 120 Specialist Groups in the SSC network. These three recipients are worthy representatives of a much broader group of SSC members".

Restoration of globally important coastal ebony forest, Ile aux Aigrettes, Mauritius. Dr John Mauremootoo, SSC Indian Ocean Plant Specialist Group. This 26ha islet supports one of the last remnants of this forest type in Mauritius (only 1% of good native forest is left) but it is under constant threat from degradation by invasive introduced plant species. A restoration project, removing alien species and re-establishing native ones was instigated in 1985 and 80% of the island's forests have been restored. This grant will enable the restoration work to be completed, safeguarding this unique habitat and its associated threatened wildlife.

Anegada iguana – implementation of the species recovery plan. Richard Hudson (and others) SSC Iguana Specialist Group. Endemic to Anegada island in the British Virgin Islands, the Anegada iguana is classified as Critically Endangered on the IUCN Red List of Threatened Species following an 80% population decline since the late 1960s. Only 200 remain, and this project aims to significantly enhance the recovery of this species through an integrated programme of population and habitat protection, releasing young iguanas reared in captivity (to reduce predation of small iguanas), feral

mammal control, and building community support for the recovery programme.

Monitoring population trends and habitat quality of the Critically Endangered Przewalski's gazelle. Dr Zhigang Jiang, SSC Conservation Breeding and Re-introduction Specialist Groups. Przewalski's gazelle is endemic to western China and is now confined to a small area around Qinghai Lake. It is classified as Critically Endangered on the IUCN Red List of Threatened Species, with an estimated population of less than 250 animals, split into five isolated sub-populations. There is no captive breeding population and extinction is a real possibility. Continuing threats include competition with livestock and extensive fencing, which prevents free movement between foraging areas and disrupts mating. This project will carry out sound, science-based research on the surviving gazelles and their habitat in order to identify specific measures for conservation action.

"The creation of the Sir Peter Scott Fund is part of a suite of measures put in place in response to the Voluntarism Study that was carried out by SSC in 2001. The study highlighted that our members need more help in fundraising and securing grants," says Jean-Christophe Vié, Acting Head of the IUCN Species Programme. "This is a modest start but we shall strive to mobilise more resources to guarantee the future of this important Fund," he added.

Funds for the first allocation of grants were generated by proceeds from sales of The Red Book: The Extinction Crisis Face to Face, sales of The IUCN Red List Collection, a series of soft toys created to promote awareness of the threats to species, and the remaining balance of the former Peter Scott Fund that was created for the production of SSC's species Action Plans. Donations to further the work are always appreciated.

For more information on the Sir Peter Scott Fund for Conservation Action see: <http://www.iucn.org/themes/ssc/programs/peterscottfund/peterscottfund.htm>

Check the www.blueiguana.ky website for recent issues of Blue Iguana Tales highlighting Team Blue 2005's field efforts in the Salina Reserve, QEII Botanic Park, and the East End. Special thanks to IRCF and IIS for recent donations to both this and the Jamaican iguana recovery program.

Iguanas in the News

Love is Blue

Chicago Tribune - February 11, 2005

By William Mullen

CHICAGO, ILLINOIS. When mating season rolls around, the Shedd Aquarium's Grand Cayman iguanas are decked out in the color of romance. Parents with young children who spot a bright blue iguana at the Shedd Aquarium in the next few weeks might consider discreetly hustling the little ones toward the seahorse exhibit or something else a little more innocuous. Marley and Eleanor, a breeding pair of Grand Cayman blue iguanas, are going on display at the aquarium.

"In breeding season, when their reproductive hormones rise to high levels in March and early April, the color of the males changes to this amazing electric blue," said Chuck Knapp, a Shedd population biologist who is a world authority on iguanas.

Found only on Grand Cayman Island, a spot of land in the Caribbean south of Cuba, the species is thought to be the world's most endangered lizard. Fewer than 25 of the dragon-like blue iguanas, which can grow to 5 feet in length, survive in the wild. Ten zoos and aquariums in the U.S. are trying to breed them in captivity to send offspring back to Grand Cayman Island for re-introduction into wild areas. The Shedd has built an elaborately engineered exhibit case as a part of the breeding effort. Marley made his debut Thursday, and Eleanor will join him later.

Female blue iguanas also take on a more definite blue hue in the mating season, though a lighter, powdery color. The rest of the year, the skin of both sexes is a drabber blue-brown.

"The color change at the mating season, especially for the males, seems to be a way of attracting prospective female mates," said Knapp. "The males are very aggressive in the mating season. He will try to scare off other males by confronting them with these large-amplitude head bobs. When he presents himself to a female, he uses a different, short little vibratory head bob to see if she is receptive. If she is, she gives him a head bob in return."

It sounds simple, but efforts to breed the species in captivity in the U.S. have been spotty, at best, as the blue iguanas were almost gone in the wild before

anybody began to study them in their natural state.

"There are a lot of variabilities in the natural world that might affect breeding that we just don't know about," said Allison Alberts, a conservation specialist at the San Diego Zoo. "We're still learning what we have to provide them in captive situations to encourage breeding. We know nutrition is important. So are the right levels of ultraviolet light in the exhibit and the social situations you place the animals in."

When Grand Cayman Island was just a sleepy fisherman's enclave, the blue iguana was the biggest native land animal and had few predators to fear. In the latter half of the 20th Century, however, Grand Cayman became an upscale center of luxury resorts and offshore banking, bringing more than 30,000 permanent human residents.

Threat grew. With the humans came pet dogs, cats and snakes. Feral dogs hunted down adult iguanas. Feral cats and snakes--not to mention introduced rat species--sought out iguana eggs and hatchlings. New homes, hotels and golf courses took over prime iguana habitats, and the lizards became common roadkill on newly built roads.

"In 1993 there were 200 to 250 of them left in the wild, but now we believe there are only 10 to 25 left," said Rick Hudson, a Ft. Worth zoo conservation biologist. "Almost every Caribbean island has its own iguana species, and the survival of most of them is nearly as tenuous," said Hudson, who with Alberts co-chairs a group of scientists overseeing Caribbean iguana conservation efforts. "There are 16 iguana species in the Caribbean, and nine are ranked critically endangered," he said. "They won't survive without some form of conservation intervention. The Grand Cayman blue iguana is the most endangered of all of them."

A group of Grand Cayman residents, alarmed in the 1990s at seeing the island's largest animal plunging toward extinction, began a rescue effort, establishing two protected areas and building, with international help, a local breeding facility. Now all the captive blue iguanas on Grand Cayman and in 10 U.S. zoos and aquariums are being treated as a single breeding population. There are 90 iguanas in the Grand Cayman breeding facility, and another 250 babies are being raised until they are old enough for release into protected reserve areas.

The genetic history of all the iguanas in Grand Cayman and the 40 iguanas in the U.S. has been determined and put on file so a committee headed by

Hudson can oversee which ones are paired for mating to avoid inbreeding. U.S. captive breeding efforts for blue iguanas fell apart in the 1990s when participating institutions discovered their early efforts were tainted by misidentification of species, producing hybrid offspring and accidental pairings of brothers and sisters.

Starting anew, the Shedd brought in Marley as a young adult in 1999, having obtained the female, Eleanor, as a hatchling in 1995. They had been housed in a basement habitat until now, and so far they have failed to produce fertilized eggs.

New habitat. The Shedd spent \$235,000 building a new 1,200-square-foot exhibit in hopes of producing hatchlings. Taking up an entire wall in the aquarium's Tropical Waters Gallery, the blue iguana habitat, built to resemble a rocky Grand Cayman seashore, has several features built to encourage breeding. "They now will live directly under skylights," said George Parsons, the aquarium's collection director, "so that they will have the natural seasonal changes in sunlight to stimulate their natural cycles. We have installed ultraviolet lights to replace the natural ultraviolet rays blocked by the skylight windows. The temperature is maintained at 85 degrees in the air, and we have hot rocks strategically placed throughout the exhibit heated to 102 degrees, where they will like to sit and bask in the UV rays."

Except during the breeding season, wild iguanas live solitary lives. To keep Marley and Eleanor from getting on each other's nerves, the habitat has many projections and corners so they can stay out of each other's sight. In nature, female iguanas bury fertilized eggs in the sand, then cover the burrow entrance to hide the eggs from intruders. The Shedd has built two cave entrances into the exhibit rockwork that lead to sand-filled nesting dens that officials hope Eleanor will one day use for her fertilized eggs.

To get them established in their new home, Marley will remain by himself in the new exhibit for a couple of weeks to acclimate himself; then he will return to the basement while Eleanor gets her chance. Before the end of the mating season, however, they will be on display together in the new exhibit. The exhibit includes a 4,000-gallon pool stocked with life commonly found near the shore of Grand Cayman.

"As an aquarium, we of course feature aquatic life," said Parsons, "but we see the need to link up how these terrestrial and aquatic environments merge along shorelines, and how human presence can endanger them."

SOS Call for Ancient Blue Iguana

BBC News - May 23, 2005

By Georgina Kenyon

CAYMAN ISLANDS. Cayman Island scientists are calling for assistance to pull a unique species of blue iguana back from the brink. The animal has a long history: DNA evidence suggests it has been around for the past three million years. However, the mere 25 of them left on Grand Cayman seemed recently to face a dismal future.

"Time is obviously not on the side of this remarkable creature," said Fred Burton, director of the Blue Iguana Recovery Programme (BIRP). "But there are no insurmountable biological, political, or social barriers to the re-establishment of a viable wild population. "Saving the blue iguana really boils down to the human financial resources we can direct to the task."

On the brink. The BIRP is significant in the study of how a species can be brought back from the brink of extinction. With a heady mixture of science, iguana ingenuity, understanding of iguana psychology, and local and international support and funding - scientists believe they may just be able to bring the iguanas back to a critical mass required to sustain a population.

The blue iguana's problems stem from humans, though for the most part the damage to the iguanas has been quite unintended. The first European settlers arrived nearly 300 years ago, and the pets that they brought with them, such as dogs and cats have continued to push the iguanas back from the coast and into less hospitable inland areas. The displacement and land-use change has accelerated with a major human population boom in the last half-century.

The blue iguanas, named because of their skin which turns slowly from slate grey to blue throughout the day as the sun shines, were once shot and eaten by people and are still attacked by pets. The iguanas do not instinctively recognise dogs and cats as lethal predators and the first chance to learn often ends in tragedy.

The BIRP hatches and rears blue iguanas for two years, so sparing them the severe mortality that would usually decimate a year's hatch. The pioneer blue iguanas are then released back into the wild and radio-tracked as they mature and start breeding. These studies are providing vital information for the development and management of a protected area.

The iguanas have strong personalities and are superbly adapted to their natural environment and they are learning to cope with today's world in different ways. As fast learners, the iguanas have expanded their natural diet of some 50 or so native plant species, to over 130 by discovering new edible plants brought to the islands by horticulturalists and landscapers. They can also adapt to a man-made environment (if there are no dogs or cats); they are as happy sleeping under a wooden shed as in a natural rock hole.

Playing cupid. Hope also lies with the design by BIRP workers of honeymoon suites for the iguanas breeding in captivity which include specially constructed retreats and a carefully prepared diet of fruits, flowers, and assorted greenery.

"Iguanas are fairly basic in this area. Good food, plenty of sunshine, and a nice place to nest and hang out and they will pretty much get on with it," said Dr Matthew Cottam, special projects officer at the Cayman Islands Department of the Environment, who works with the BIRP.

But is it too late for the iguanas? Can they be saved?

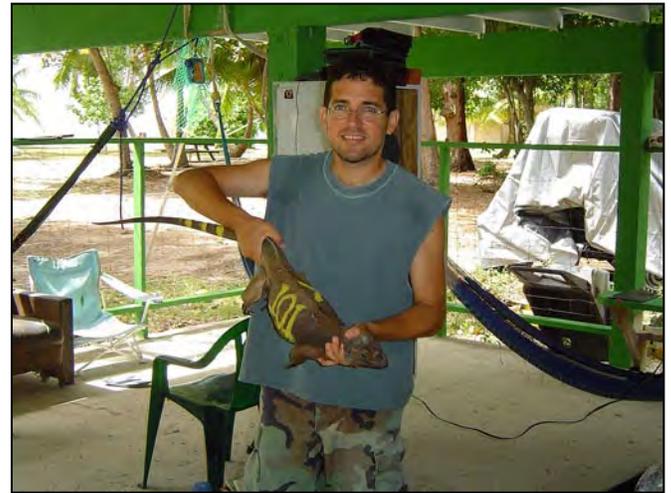
"The captive breeding programme is going from strength to strength," said Fred Burton. "Our monitored releases are working brilliantly so far. If we can protect enough habitat and maintain it free of unnatural predators, there is every reason to hope we can give the blue iguanas their future back. This is one species we can save."

Taxon Reports

Mona Island iguana (*Cyclura cornuta stejnegeri*)

The Successful Release of Head-start Mona Island Iguanas

The Mona Island iguana (*Cyclura cornuta stejnegeri*) was listed as endangered in The Regulation to Govern the Threatened and Endangered Species in The Commonwealth of Puerto Rico (2004) and in the Recovery Plan for the Mona Island Iguana (USFW 1984). The reduced recruitment of juveniles into the adult population due to exotic mammal predation provoked the implementation of a head-start program in 1999. This



Recaptured iguana "Xena", with an inactive internal transmitter (released April 2002, recaptured July 2004) held by Alberto Alvarez. Photo by Miguel Garcia.

initiative was developed by the Puerto Rico Department of Natural and Environmental Resources (PRDNER), with collaboration of the IUCN Iguana Specialist Group, the US Fish and Wildlife Service, the Toledo Zoological Gardens and assistance from the University of Puerto Rico.

By March 2005, 69 head-start iguanas have been released in several nesting areas of the coastal plain where they were collected as hatchlings in 1999 and 2000. These iguanas had gained biomass rapidly, reaching releasing conditions after 18 months in captivity. The mean body mass of the released individuals was 949 grams \pm 184, with a mean SVL of 25.7 cm \pm 1.8. Twenty-three (23) iguanas have been recaptured and three of them are currently being radio-tracked. Six animals were recaptured twice, and another one three times in a 2.5 year period. Most of the recaptures were made about 500 meters from their respective release areas. The farthest animal recaptured was 700 meters from the release point. All the animals were healthy and active. Based on recapture information, most of the released iguanas grew at a higher rate than in captivity. Some iguanas gained more than two kilograms in less than two years. Most of them had lost their external marks (beads) and these were replaced with new ones in a different place of the crest. Four of the recaptured iguanas had inactive internal transmitters implanted in April 2002.

During the 2004 season, two nesting females observed turned out to be head-start iguanas released in August 2002. Unfortunately, one of the nesting females was found dead, apparently hit by a vehicle. Hatch-

lings of one of those nests emerged and were collected in October 2004. Next releases will be made in Playa de Pájaros area with iguanas from this site. We could greatly increase the number of released iguanas. Nevertheless, it is important to first determine scientifically the number of iguanas needed to cause a sustainable growth of the population.

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Mona Iguana Nesting Seasons 2003 and 2004

We monitored the hatching success of 23 nests (273 eggs) of the Mona Island iguana (*Cyclura cornuta stejnegeri*) during October 2003 and 2004 nesting seasons. This initiative is part of a paternity study being conducted at the Biology Department of the University of Puerto Rico. From the 23 females, seven nested in 2003 and 2004. Their offspring were collected over the two years, to determine if the fathers of those hatchlings were the same during the two consecutive years of the study. Mother iguanas, and most of the potential fathers, are well known iguanas living year-round in three study areas, most of which have been monitored by radio telemetry through climatic and reproductive seasons. In addition, all hatchlings from the 23 nests were measured sexed, pit-tagged, and tissue sampled. Radio telemetry studies on Mona Island iguana hatchlings showed that natal dispersal lasted up to three weeks (Pérez-Buitrago 2000). Therefore, most of the hatchlings were kept in captivity for a month to prevent natal dispersal, and then released into the surrounding areas where they were originally collected to try to obtain information regarding survival and growth rates. To date, no recaptures of those hatchlings have been conducted even though the release areas are very well surveyed.

Thirty hatchlings from each year are still in captivity as part of a head-start program headed by the Puerto Rico Department of Natural and Environmental

Resources (PRDNER) and will be released in their respective collection areas when they reach the final target size of at least 700 g and 22 cm SVL. Hatching success was 77% and 55% in 2003 and 2004, respectively. The 55% obtained in 2004 was mostly due to three individuals, two very large female that laid 24 eggs (twice as much as the average reported of 12 eggs per nest!!) and a young female (probably a first-year mother) that laid 11 eggs. Eggs from both nests failed to develop and were possibly infertile (i.e. only yolk inside). However, we cannot discard the possibility that embryos aborted in the very early stages of development. Excluding those “bad” nests from the hatching success calculation, it rose to 75% for 2004.

The 2003 hatching season gave us some experience to artificially incubate eggs successfully. During that season, we were forced to move a nest that was laid on a heavy traffic road. The hatching success for that nest was 100%, proving that it was possible to relocate Mona Island iguana nests with success. In 2004, we artificially incubated 33 eggs, from multiple nests, that showed delayed hatching relative to their siblings. The hatching success of these eggs was 91%. Two of the incubated eggs were accidentally broken when handled, but also hatched successfully. The broken eggshells were replaced with waterproof paper pieces from a field notebook and sprayed with water to provide darkness and moisture.

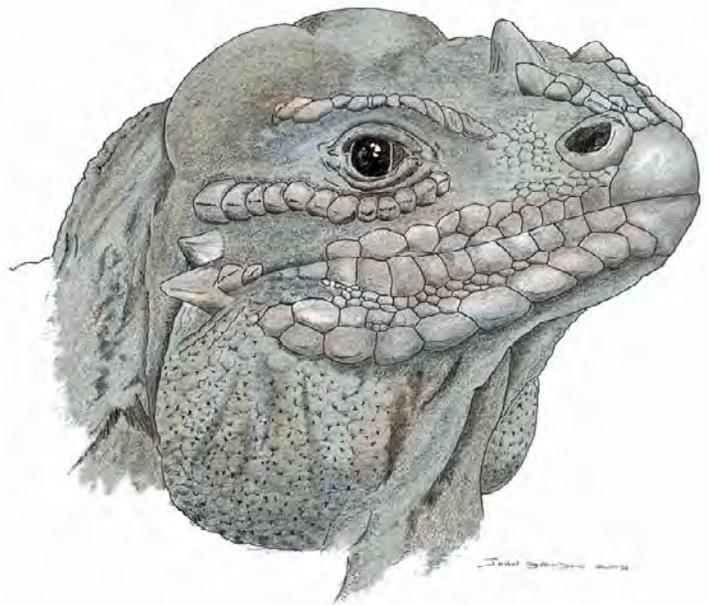


Illustration by John Bendon of iguana #27, one of the friendliest animals that was once radiotagged and nested close to the research facility in 2003 and 2004.

During our observations of nesting activity on Mona, we observed several novel events. First, we noticed that seven hatchlings became sick soon after hatching. Six out of the seven were from the same nest and all developed similar disease pathologies. When the disease began, individuals had “dropping eyeballs”, with the pupil discernible just above the lower eyelid. As it progressed, the eyes became very sticky because of lachrymal secretions and often became sealed shut. The eyes themselves looked collapsed and all animals were apparently blind. The affected eyes were cleaned regularly with water but failed to recover. Eventually, animals stopped drinking and became listless and limp. All died and two dead hatchlings were sent to the Toledo Zoo for necropsy, where head veterinarian (Dr. Tim Reichard) suggested the condition was likely a bacterial or fungal infection that might have been acquired during the egg stage or right after hatching.

In addition, we noted that six females re-visited their respective nesting places at the exact time when the eggs were expected to hatch. The ‘visit’ consisted of iguanas ‘hanging around’ right after collecting the hatchlings from the nests. These iguanas checked the excavated nests and pushed soil around with their snout. It is unclear if they were looking for the chamber or were simply attracted by the activity. (e.g. soil removal). Moreover, two different females refilled the cavity with soil that we made while collecting the hatchlings. The longest movement documented for a female showing this apparent homing (nesting) behaviour was 300 m from her year-round core area. The typical core area for Mona adult iguanas does not exceed 70 m in diameter (unpublished data).

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Andros Island iguana (*Cyclura cyclura cyclura*)

2004 Shedd Aquarium Research Update,
9 May to 13 June 2004

The beginning of the 2004 iguana field research proved to be very successful. The season was initiated with a seven-day John G. Shedd Aquarium’s research expedition aboard the R/V Coral Reef II. We concentrated the majority of the work at two long-term study sites: Sandy Cay in South Bight, and a tri-lobed peninsula (Dissertation Point) located in Lisbon Creek off the east/southeast portion of Mangrove Cay. Work consisted of continuing with our mark/recapture sequences, exploring for new, and monitoring old nests for activity, and radio tracking five females on Sandy Cay.

We captured 36 iguanas (22 males/14 females; 19 recaptures) ranging from 280 grams to 6.88 kg in body mass, and 21.6 to 52.3 cm snout vent length. We attempted to track females with 2003 radio transmitters that had remaining battery power. Unfortunately, the batteries expired soon after attachment for most iguanas. We do have good data for one female, which documents her extraordinary movement patterns in search of a suitable oviposition site. She was eventually tracked to her mound nest on 6 June.

On 10 May we discovered the first nest of the season - a recently oviposited clutch of eggs on Linder Cay, Lisbon Creek. The eggs were deposited in a termite mound adjacent to a mangrove flat by the same female that used the mound in 2003. The same female was also the first recorded user of a mound in 2003.

Using the Shedd Aquarium research expedition as a building block, Audrey Owens and I continued



Hunting camp at the mouth of Honeycutt Creek.
Photo by Chuck Knapp.

with the project until 14 June. We captured 22 iguanas (3 males, 18 females, 1 juvenile; 9 recaptures) ranging from 47 grams to 9.17 kg in mass, and 10.3 to 56.5 cm snout vent length. The skewed sex ratio of captured individuals is an artifact of our nesting ecology study and subsequent captures of guarding females.

We excavated 22 nests at seven sites and recorded data including clutch size and morphometrics, mound dimensions, and nesting female body size. We also placed thermal data loggers in ten mounds and took detailed measurements and drawings of the internal mound structures. A significant discovery was the apparent facultative nesting behavior of females. On two occasions, we documented females using sand instead of termite mounds for oviposition. The first occurrence was documented from an unmarked female that eluded capture. The second recording occurred after a female from 2003 destroyed her old mound by over-aggressive digging. Her nest was found 1.5 weeks later ~300 meters south of her 2003 mound. The eggs were deposited in course sand ~10 cm below the surface. The site was only ~50 cm above the high tide mark (see photo). Both occurrences of using sand for oviposition were recorded on North Dissertation Point.

Of the 12 nests known to have been used in 2003, eight were used by new females. In one instance, the mound of a 2003 user was destroyed and the female appeared 300 meters away at another nest used in 2003 and evicted the resident female to deposit her clutch of eggs. We also documented an unknown (prior to 2004) female get evicted from the mound after depositing her eggs. Before the female was evicted, the eggs were discovered by white crabs (*Cardisoma gunabumi*) and destroyed. Two days later, a new unmarked female deposited her eggs in the mound. We documented a second nest completely destroyed because of crabs. We suspect additional predation in the weeks following oviposition. Mean clutch size was 9.4 (range 5 to 18). Additional clutch data are still being analyzed.

We continued our in-depth ethnographic interviews with locals. We discovered in conversations that six goats have been put on Linder Cay. This is a concern because the cay provides very good habitat for iguanas. Additionally, we heard anecdotal stories of people staying at the hunting camp at the mouth of Honeycutt Creek during the last week of April. A bonefish guide from Tiamo Resorts was in the area and the men offered him iguanas for sale at \$150 per animal. They allegedly had 40 iguanas in their possession and were bringing

Sand nest on North Dissertation Point (Mangrove Cay). Photo by Charles Knapp.



them to North Andros for sale. We heard another story about men from Mangrove Cay going to the same area at the end of 2003 and collected ten iguanas for sale on North Andros for \$50 per animal. The price range is corroborated with multiple independent interviews over the past three years, though I think \$50 is more realistic and most often quoted.

We visited the camp on 23 May and found the area very much in use. More garbage than usual was around and the area was recently burned. A new tarp was also in place over the wooden frame that is normally in the camp. Shed iguana skin was all over the camp. A step could not be taken without stepping on skin. We found iguana bones and an intact skull. We also found the skull of a green sea turtle. It is evident that illegal hunting is still occurring and for commercial purposes. I propose immediate action be taken such as enforcing existing laws or initiating warden protection.

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Allen Cays iguana (*Cyclura cychlura inornata*)

Research Report 10 to 18 May 2004

Allen Cays. This spring in the northern Bahamas was one of windy, cool, and dry conditions, and that pattern continued during our survey work. The vegetation in the Allen Cays reflected the drought with colors dominated by brown and orange rather than green, and little fruiting and flowering. The weather not only reduced the available high-quality food for the iguanas, but it also reduced tourist boat visitation, and hence, food supplementation of the iguanas by humans. As a result many individual recaptured iguanas weighed less than they did a year ago.

Winds blew nearly constantly at 20 knots during our visit, keeping temperatures cool. As a result iguanas were late to emerge in the mornings, avoided the windward sides of the islands when possible, and retreated early in the evening. However, with a field team comprised mostly of students from previous trips, we captured a record total 535 Allen Cays iguanas this year (including 27 carcasses). Representing more than half of all existing individuals. We captured 376 iguanas (69% of them recaptures) on Leaf Cay and 124 (90% recaptures) on U Cay. First year iguanas were particularly obvious this year on Leaf Cay, and we captured 42 of them. We have now accumulated 5043 iguana captures over the past 24 years.

We found a disturbing number of carcasses on both Leaf (18) and U Cays (9) this year (compared to only six total last year, but 26 and 22 during six weeks of field work each year in 2002 and 2001, respectively). Many of these were large males, continuing a pattern of reduction in the number of large males on the islands. Indeed, of 30 large males (> 40 cm SVL) captured on U Cay in 2000, only 27 were recaptured in 2001, 24 in 2002, 17 in 2003, and 11 in 2004. This suggests an annual survival rate of only about 78%, well below the over 90% that we believe is normal. Similarly, on Leaf Cay, of 15 large males alive in 2002, only nine (60%) were alive/captured in 2003 and five of those (56%) were alive/captured in 2004; 12 of those from 2002 were from the big west beach (i.e., likely to be caught if alive) and only seven of those (58%) were caught in 2003 and only five of those (71%) were caught in 2004. There can be no doubt that large males are disappearing (some through unnatural death, some to unauthorized removal) from the Cays at an alarming

rate. All carcasses and skeletons were salvaged and given to Sandra Buckner for archival purposes.

The removal of large males is also evidenced by the recent decline in the mean size (SVL in cm) of the largest ten males captured on Leaf Cay over the past ten years: 42.9 in 1994, 42.9 in 1995, 42.3 in 1996, 44.0 in 1998, 43.0 in 2000, 42.1 in 2001, 42.0 in 2002, 41.4 in 2003, and 40.8 this year.

As we recommended in previous reports it seems that there is a desperate need for the construction of a bilingual “iguana information kiosk” on both Leaf and U Cays. Not only could this provide general natural history information to interested tourists, but it could also explain the dangers of harassing, improperly feeding, and relocating the iguanas, as well as the potential threats presented by feral animals.

In previous years we had found three mummified carcasses or partial skeletons of iguanas wedged in the crotches of trees on Leaf Cay (as well once for *Cyclura rileyi* on Bush Hill Cay). This year we encountered a subadult trapped between the multiple trunks of a tree (cf. *Drypetes diversifolia*) on Leaf Cay. The animal was emaciated and weak, and had apparently been trapped for some time. We rehydrated and hand fed it over the next 36 hours, and then released it near where it had been found. However, we were not certain whether it would recover. Clearly, this means of accidental death is more common than might be assumed.

Windy conditions prevented our visit to Flat Rock Reef Cay; however, we did walk the entire length of Allen Cay and captured nine “giant” iguanas there, including two females and seven males (seven of the total being recaptures, and two of those being animals



Juvenile *Cyclura cychlura inornata*.
Photo by John Iverson.

originally marked on Leaf Cay!). We have now marked a total of 15 iguanas on Allen Cay (including the two recent mysterious introductions from Leaf Cay), and we are confident that fewer than five additional animals could be present. This year we neither saw nor heard evidence of juveniles, so we are still uncertain if reproduction is possible on this Cay given the lack of apparent nesting substrates. As evidenced by the great numbers of fresh carcasses, the high rate of predation on adult Audubon's Shearwaters on Allen Cay continues, primarily by local barn owls. Since iguanas seem not to be responsible for that predation, it may be time to reconsider our earlier plan to carry sand to upland sites on Allen Cay to create iguana nesting habitat on that island.

Stephanie James of the Wildlife Conservation Society at the Bronx Zoo in New York joined us for our first three days in the Allen Cays, and collected fecal and blood samples from 41 iguanas (38 from Leaf Cay and three from Allen Cay) for baseline health screening. We are hopeful that funding will permit her to collect blood from U Cay animals in 2005.

Tail breaks frequencies remain quite low for the Allen Cay iguanas: Leaf Cay females, 9.0%, Leaf Cay males, 7.2%; U Cay females, 11.3%; U Cay males, 11.9%. Sex ratios were not significantly different from unity, with 153 sexable females and 167 sexable males captured on Leaf Cay, and 62 sexable females and 59 sexable males captured on U Cay.

We once again recorded the precise capture location of nearly every iguana this year. As has been the pattern, most captures were made on the big west beach of Leaf Cay (only ca. 2% of the total island area), with 173 of 371 (47%) being made there (58% in 2003; 44% in 2002). The attraction of the iguanas to the feeding beach is obvious.

This year we implanted an additional 66 electronic identification (PIT) tags in iguanas, and have now PIT-tagged a total of 572 lizards. We had only one PIT tag failure this year. The failure rate of PIT tags has been quite low our 11 years of using them, as has been the failure rate of toe clips due to natural toe loss. We were even able to identify 7 of 27 carcasses that we found by scanning the remains and the nearby sand. We plan to continue to PIT tag 50-70 additional larger animals each year as funds allow.

Bush Hill Cay. For the third year in a row we visited Bush Hill Cay to census the introduced population of

Cyclura rileyi there. We captured and processed iguana in the afternoon of 17 May and the early morning of 18 May. This year we caught 105 iguanas (45 males, 60 females; 63 new, 42 recaptures; plus one fresh carcass left on the Cay). We have now marked a total of 192 iguanas on Bush Hill and recorded 58 total recaptures.

Last year a simple Lincoln Index using 2002-03 recapture data (and assuming no mortality between sampling) estimated the adult population on Bush Hill at 319. The same calculation based on this year's adult recaptures (126 previously marked; 105 captures, including 42 recaptures) estimated 315 individuals. In addition, for the 68 iguanas caught in 2003, we recaptured 22 of them in 2004, for an estimate of 325 individuals. Though crude, these estimates are consistent and seem to be reasonable minimum estimates based on our observations. However, juveniles are still relatively uncommon on the Cay considering the size of the adult population. We suspect that the high density of adults may result in cannibalism of small juveniles.

Tail break frequency on Bush Hill Cay (53.3% in females; 53.3% in males) remains over five times the rate in the Allen Cays. In addition, of the 63 new iguanas captured this year, 18 had toes missing naturally (9 males, 8 females, 1 unsexed). Many others showed clear evidence of bite marks from other iguanas. Given the high rate of natural toe loss on Bush Hill, the use of PIT tags there seems warranted for identification purposes. We captured only one iguana that had neck beads present, left from Bill Hayes' work on the cay in 1997.

Based on 50 recaptures of adult Bush Hill iguanas over the past three years, adult males ($n = 28$) grew an average of 0.37 cm/yr (range: -1.2 to 3.2 cm), and adult females ($n = 22$) grew an average of 0.30 cm/yr (range: -1.1 to 2.0 cm). Von Bertalanffy growth equations calculated from those data and the single capture of an 11.2 cm SVL juvenile captured 21 May 2003 and estimated to be 0.7 years old are: male, $SVL = 35.16 (1-57.92-0.135t)$; female, $SVL = 31.47(1-121.25-0.131t)$. The latter preliminary equation suggests that females reach 24 cm SVL in about ten years.

As previously reported Bush Hill Cay iguanas are greatly polymorphic in color (from brilliant yellow to bright mottled orange to gray, brown and even almost cream colored). Yellow iguanas captured this

year included both males ($n = 3$) and females ($n = 2$) and remain an enigma. The remaining morphs seem to include a continuum from very dull colored (gray, brown, cream) to almost uniform orange. Intermediates are mottled with increasing amounts of orange. Although color is not precisely dimorphic, there is a tendency for females to be brown or gray or gray mottled (53%), and for males to be orange or orange mottled (63%). Studies of the basis for this color variation (including its genetic versus environmental basis and its relationship to social behavior) are sorely needed.

All Bush Hill Cay data have been forwarded to Drs. Hayes and Carter for their continuing studies of this species (as well as to Sandra Buckner), and are available to others upon request.

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Cuban iguana (*Cyclura nubila nubila*)

Selection of habitat of Cuban iguana (*Cyclura nubila nubila*) in Juan García Cay, San Felipe's Cays, Cuba.

Edited from Spanish by ISG newsletter editors.

This article summarizes a study on habitat selection by the Cuban iguanas (*Cyclura nubila nubila*) carried out on Juan García Cay, San Felipe's Cays, south of Pinar del Río, Cuba from February, 2000 to January, 2001. The following vegetation associations on sandy

substratum were identified: *Batis maritima* grassland, coast xeromorphic shrub, (sandy) coast vegetation, and herbaceous *Rinchospora* dominated vegetation. Use of each of these habitats was evaluated in terms of relative abundance of iguanas, taking into account the number of active individuals found, fecal deposits, and retreat sites during 30 minute transects. The timing of surveys was randomized across habitats, with an equal proportion of observations occurring during the dry and wet seasons. To determine habitat selection we used the methodology of Thomas and Taylor (1990) and Neu et al. (1974), which calculates percent use relative to percent of availability of each studied habitat.

Results and discussion. The relative abundance of active iguanas shows an evident pattern of gradual decrease from *Rinchospora* habitat (6.8 iguanas/hectare) to coast vegetation (1.2 iguanas/hectare), with intermediate values in *Batis* and coast xeromorphic shrub (Table I). Statistically, the most preferred and least preferred habitats differ significantly from each other and from the intermediate habitats, but there is no significant difference in preference between sandy coast vegetation and coast xeromorphic shrub. These habitats appear to function equally well with regard to iguana density, despite their very different ecological characteristics. The relative abundance of iguanas in *Batis* and coast xeromorphic shrub seems to be typical compared to abundance of iguanas in these habitats on other cays. The small number of iguanas found in coast vegetation may be due to the fact that this is neither a feeding nor a shelter area, while the high value recorded in the *Rinchospora* habitat is possibly due to the fact that the shelters are more concentrated in this area.

The coast xeromorphic shrub shows the greatest density of retreats per 30 minutes, followed by *Rinchospora* and *Batis*. All mean values for retreats differed across habitats. No retreat sites were detected in coast vegetation, perhaps due to three main factors: high exposure with little vegetation cover and very loose sandy substratum. The mean frequency of fecal deposits per habitat do not differ statistically for *Rinchospora*, *Batis*, and coast xeromorphic shrub, but in coast vegetation we detected feces about twice as often as in other habitats, a difference that was statistically significant. This result coincides perfectly with information given by local fishermen who affirm that iguanas go early in the day to the coast to defecate and later penetrate into

the cay, where they only defecate rarely while they are engaged in other activities.

The degree of habitat selectivity in relation to the three analyzed variables (active iguanas, retreats, and fecal deposits) is shown in Table 2. The iguanas prefer *Rinchospora* and *Batis* habitats, whereas coast xeromorphic shrub is not preferred and coast vegetation is used in proportion to its abundance in the environment. Assuming equal activity and detection probability among habitats and relative abundance directly proportional to density, then there is high iguana density in *Rinchospora* and *Batis*, even if they do not appear to be optimal habitats (in terms of shelter and food plant species) for iguanas. It is possible that these habitats function as sink areas, where young and old individuals go when they are rejected from the best habitat by territorial adults (which may explain the lower density in apparently higher quality habitats), a phenomenon known as a despotic distribution (Fretwell and Lucas, 1970; Van Horne, 1983).

The preferred habitat for excavation of retreats is *Rinchospora*, despite the small area, because this habitat has highly favorable conditions for excavation, including high cover and fine sand. The finding that *Batis* is not preferred is expected because there is no adequate substratum for excavation of shelters despite its relatively large area. Coast xeromorphic shrub is used in proportion to its abundance. Feces are deposited preferentially in *Rinchospora* and coast vegetation. In coast vegetation, this result is explained by the ob-

served pattern of early morning migration to beaches already mentioned. This may simultaneously explain the lack of preferential use of coast xeromorphic shrub by iguanas for defecation. *Batis* is used in proportion to its abundance.

In summary, all habitats studied seem to be important for iguanas to carry out their vital daily functions.

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Habitat Types	Iguanas			Retreats			Fecal Deposits		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
<i>Rinchospora</i>	12	6.8 ^a	4.4	12	5.2 ^b	3.7	12	16.6 ^b	10.5
<i>Batis</i>	11	4.8 ^b	3.1	6	0.7 ^c	0.5	12	11.6 ^b	7.5
Coast xeromorphic shrub	16	3.2 ^b	2.1	16	10.3 ^a	3.8	16	16.3 ^b	11.5
Sandy coast vegetation	16	1.2 ^c	1.7	-	-	-	16	28.0 ^a	19.2
F (ANOVA)	20.4(p<0.001)			42.7 (p<0.001)			3.9 (p<0.05)		

Table 1. Mean relative abundance of iguanas (N = number of sightings per 30 minutes), retreats, and fecal deposits on Juan García Cay, San Felipe's Cays. a, b, c = means with significant differences, p < 0.05.

Habitat Types	Habitat Availability		Iguanas			Retreats			Fecal Deposits		
	Area (ha)	% Cover	Mean # Observations	% Use	Use / Cover	Mean # Observations	% Use	Use / Cover	Mean # Observations	% Use	Use / Cover
<i>Rinchospora</i>	11.1	16.0	10.7	40.2	2.51 ⁺	8.9	30	1.71 ⁺	27.7	20.9	1.30 ⁺
<i>Batis</i>	12.9	18.6	8.4	31.6	1.69 ⁺	1	3.4	0.16	20.5	15.5	0.83
Coast xeromorphic shrub	39.4	56.8	5.4	20.3	0.35 ⁻	19.7	66.6	1.17	24.7	18.6	0.32 ⁻
Sandy coast vegetation	6.0	8.6	2.1	7.9	0.92	-	-	-	59.7	45	5.23 ⁺
χ^2	-		18.8 (p < 0.001)			6.8 (p < 0.05)			241.3 (p < 0.001)		

Table 2. Habitat selectivity by iguanas, including direct sightings, retreats, and fecal deposits, on Juan García Cay, San Felipe's Cays. Using Bonferroni's statistic: + = preferred habitat, - = non-preferred habitat, and 0 = habitat used proportionally.

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