

Recent Literature

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Iguana Specialist Group Newsletter

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2006 ISG Annual Meeting

ISG Meeting Minutes
 November 10-12, 2006
 Lajas, Puerto Rico

Thanks to Miguel Garcia, Alberto Alvarez, Nestor Perez, and all the fabulous staff at the Departamento de Recursos Naturales y Ambientales, the 2006 annual Iguana Specialist Group meeting was very productive and enjoyable. The meeting was held in Lajas on the southwestern coast. Field trips were scheduled to Caja de Muertos island and also Magueyes island, where the introduced Cuban iguana is abundant. This was the second time the Specialist Group has met on this island and enjoyed the warm and generous Puerto Rican hospitality!



Left to Right. Standing: Hugh and Sandra Buckner, Ivan and Katarina Rehak, Tarren Wagener, Samantha Addinall, Allison Alberts, Fred Burton, Lee Pagni, Rex McAliley, Karen Graham, Jan Ramer, Stephan Funk, John Kunna, Larry Buckley, Stesha Pasachnik, Bill Modi, Rick Hudson, John Kinkaid, Victor Reynoso, Ernst Rupp. Sitting: Alberto Puente, Georgina Kenyon, John Bendon, Alberto Alvarez, Chuck Knapp, Candee Ellsworth, Tandora Grant, Catherine Stephen, Byron Wilson, Joe Burgess, Miguel Garcia, Bonnie Raphael, Gustavo Olivieri, John Iverson, Kirsten Hines, and Glenn Gerber. Not pictured: Nestor Perez and Peter Tolson.



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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Taxon Report Session

GRAND CAYMAN - Burton

Blue Iguana Recovery Program Update: Nov 2005 to Nov 2006. Fred Burton (National Trust for the Cayman Islands).

Salina Reserve Releases - Shortly after last year's ISG meeting, the Blue Iguana Recovery Program (BIRP) geared up to release 68 two-year-old Blues into the Salina Reserve, adding to the 25 that were released in late 2004. This involved manufacturing 68 release retreats, which were built locally by the Rotary Club of Grand Cayman Central. Bolstered by local volunteers, the BIRP then had them airlifted by helicopter into two central points in the North and Central release zones. Craig Pelke (Milwaukee County Zoo) then joined the team to distribute the retreats to their final locations, which required extension of the existing trail system. The 68 two-year-old iguanas designated for release were health screened by Dr. Paul Calle and Kate McKlave (WCS, Bronx). Jessica Hite (University of Tennessee) assisted with the release, and continued to map the locations of all the release retreats accurately by averaging multiple GPS readings. All 68 iguanas were free in the Salina Reserve by the end of December 2005, along with four more that were released to the QEII Botanic Park.

The following May through July, we recaptured as many of the 2004 and 2005 releasees possible to assess their growth. We recaptured, or at least observed, 84% of the 2004 release, and 50% of the 2005 release. This should not be regarded as evidence of lower survival rate for the second group, but rather that the population is now so large we should not expect to see and catch them all in the time frame of our summer field season. Also, the younger animals were more cryptic in the presence of older individuals. We are moving past the point where total population censuses are realistic, and we will need to shift to sampling techniques for ongoing population monitoring. In 2006, we observed three of the 2004-release females nest and at least one

has successfully emerged. This is the first documented breeding in the Salina Reserve since we began restoring a population there.

So far, we've seen little evidence of rats in the Salina, but fresh cat scat was found at one location and soon after a feral cat was trapped. To date, we have never seen dogs in the release zone, and it seems likely we won't, as long as the trail access is not improved too much. Chuck Knapp and Jeff Lemm (San Diego Zoo) created a trail to the southernmost soil zone in the Salina Reserve, expanding the area available for future releases.

Immediately following the 2006 ISG meeting, Team Blue 2006 volunteers will be arriving and gearing up to release 114 more Blues to the Salina. This time, we plan to release some yearlings as well as two-year olds, with the aim of comparing survival rates by analyzing recapture or census data over a number of years.

Genetically speaking, we won't want to release anything like this number in coming years – the focus now needs to switch to breeding under-represented genetic lines and making sure we have at least 20 different founders well represented in the released population. We still haven't completed data entry and analysis of the summer tracking data. This, and perhaps one more summer's work, should be enough to allow us to quantify the carrying capacity of the Salina Reserve for Blue Iguanas, with a reasonable degree of confidence.

QEII Botanic Park Hatchlings - The released population in the QEIIBP is of a much smaller scale than the population restoration in the Salina, but it has been the engine for headstarting large numbers of hatchlings for release. Since enough genetic representation from the QEIIBP is present in the Salina Reserve now, eggs were left in the ground to hatch naturally this year.

Seven nests were corralled in September and two hatched by early November. Those hatchlings were PIT and bead tagged along with a number of others from uncorralled nests that were found running around in the Park. Over the following weeks we caught and scanned 29 *Alsophis cantherigerus* snakes, but didn't pick up any hatchling PIT tag signals. We managed to monitor several hatchlings for quite long periods, without using radio transmitters. They all spent most of the time high up in trees, and showed no interest

Publishers and others in the business world are experts at sniffing-out a free lunch, and photographers who know little about how the industry works are an easy target. Every time you give someone free use to a photo, word will spread fast; and others will probably appropriate your images for more free uses down the road, perhaps unknown to you. Once started, it's tough to stop, as some of you have already discovered. Also, if you give duplicates, similars, or even "rejects" to potential buyers, chances are good that we will lose a sale. Our invoices provide a contractual understanding of rights granted for each use of your photos and establish limitations on future use.

Free Uses - The ISG Archive was created to benefit our members, directly through access to archived images and indirectly from license fees from buyers. For example, you should be entitled to free use of our group's photos destined to be published in conservation posters or booklets, the profits from which (if sold) will come back to you to help to support your scientific or educational projects endorsed by the ISG.

Photos should also be provided gratis for use in official internal publications of the ISG, the IUCN, the IIF, the IRCF or an affiliated not-for-profit organization that is sustained by non-paid members. But beware of organizations claiming an affiliation with these groups. Take, for example, the Alliance of Zero Extinction. The IIF is a member of the AZE, an all-volunteer group, so donating photos for use in the AZE newsletter would be acceptable. BUT it would not be appropriate to donate photos for use by the other 51 AZE member organizations, most of which are institutions. If in doubt, write or call me.

So please support YOUR archive. Without your unilateral support, I'm wasting precious time and hard-earned expertise needed to manage this image library. Please discuss these concerns at the 2006 ISG conference and call for a vote among members attending. I also ask that anyone who disagrees with our policy as proposed, make your feelings known at the conference. If we don't hear from you, I'll assume that you have agreed to refer all outside requests for photos to this office. Members not attending will be contacted via listserv after the conference.

Thomas Wiewandt
tom@wildhorizons.com

Joint ISG and IIF Meeting 2008

To highlight the critical needs of the threatened group of Mexican *Ctenosaurs*, the ISG will conduct their annual meeting on Utila Island, in the early half of January 2008. The goal of the workshop is to bring together local stake holders to try to develop a management plan and to seek solutions to curb further declines. We regret that we have to depart from our normal November meeting schedule but weather conditions in this area during that time are generally wet and misearable. We realize that this will be an inconvenience to some but the ISG Steering Committee agreed to shift dates. The IIF will meet in Houston (a common stopover for Honduras) before or after the ISG meeting.

Stesha Pasachnik is handling local arrangements and has made reservations at the Coral View on Utila. They have a total of 18 rooms that includes 35 beds (some rooms are singles and some doubles). They are getting bunkbeds that will add 21 beds but this is not yet in place. They have all the equipment for presentations and have given us a price of \$48 US dollars per person per day which includes three meals and two coffee breaks (coffee breaks for three days). Getting there may be a little pricey; international flights need to be arranged to San Pedro Sula and we will charter a local airline to Utila.

This workshop will provide several opportunities locally to see iguanas. We will visit the Iguana Research Station on Utila, home of the *Ctenosaura bakeri* program, and take a day trip by boat to the Cayos Cochinos to see *C. melanosterna*. This workshop could be our most logistically challenging yet, including a need for translation service for much of the dialog. At this point we need to get a preliminary headcount of attendees to predict lodging and charter needs. Please email Rick Hudson and Stesha Pasachnik by July 15th if you are planning to attend.

Thanks and hope to see you in Honduras, 2008!!

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Jamaican iguanas (*Cyclura collei*) hatch at the Indianapolis Zoo, celebrating the first successful breeding of this species outside of Jamaica. Photo by Richard Reams.

ISG Photo Archive – Request for a Policy Consensus.

Thomas Wiewandt (*Wild Horizons*)

As ISG members know, we have a photographic archive, still in its infancy and without ground rules. Issues have been surfacing since our November 2005 meeting in Andros that must be addressed now. We need EVERYONE'S cooperation and a consensus on policy to make this work well for all.

Be aware that if you are the creator of photographs supplied to our ISG Archive or Wildscreen's ARKive, you will always retain copyright ownership of those images and be properly credited for their use. We do not sell photographs; for a fee, we license rights for their one-time, project-specific use. This is a somewhat complex, time-tested business. It will work for us IF AND ONLY IF everyone agrees to consistently refer inquiries about your photos directly back to the person(s) running our ISG archive.

The good news is that doing it this way takes you off the hook. Photo buyers seldom offer details about their intended use, and unless you know what questions to ask, you'll never be able to determine a fair usage fee, limit their use of your photo in writing, and negotiate fees due for additional uses. Plead ignorance if you choose, but insist that they submit an official inquiry to our archive. You'll find my contact info at the end of this memo.

With the advent of the digital age, the number of photographs "out there" seems to be growing exponentially and their perceived value has been diminishing accordingly. But keep in mind that specialized images, such as yours (!), have continued to hold their value because they are difficult to get, and this is unlikely to change.

Uses for which a Licensing Fee Should be Charged - If the person asking for photos to use in a publication, exhibit, or other project is doing this on behalf of an institution or organization that clearly has a budget to produce the end result, they should pay a licensing fee. In a practical sense, if staff members, writers, and designers helping to create the work are being paid for their services, photographs should be paid for as well. Often the work would have no impact or relevance without photographs, and it's simply wrong to expect us to contribute pictures gratis.

In conservation work, there are many gray areas, too many to cover in this memo. Each must be evaluated on a case-by-case basis. When in doubt, contact our archive manager. Entire books have been devoted to setting and negotiating fair fees for photo rights licenses. Fees are always based on the kind and extent of rights required; the more prominent and extensive, the higher the fee. I always try to work within perceived budget limitations of the buyer, and our absolute minimum is \$150/use. Large non-profits usually plead poverty, a position that's rarely justified; and I regularly license photos to them.

at all in the hatchling retreats we so carefully prepared for them!

Dog Predation - At the height of the nesting season, two wild dogs (abandoned after the hurricane?), entered the Park and killed adult free-roaming Blue Iguanas known as "Slugger" and "Sapphire", and also maimed the nesting female "Yellow Blue". This is a harsh reminder that we still haven't solved the problems that led to the decline of this species in the first place.

Captive Facility - Last year, Mike Fouraker and colleagues from the Fort Worth Zoo built a storage and food preparation shed, battling extraordinarily wet and windy weather to meet an improbable deadline. With funding from the Dart Foundation we have subdivided the original large WWF pen into four, effectively gaining three new pens. We still need to build more, though, as our young potential founders mature and grow and the emphasis switches from needing juvenile cages to space-hungry adult-sized pens. We've secured the captive facility with a fence, both for security, and to control tours for income. We are also starting conceptual plans for a visitor centre and research centre at the facility.

As a result of this December's release, the stock of captives will drop considerably, and we are not recruiting nearly as many hatchlings to the captive facility since we need to focus now on different genetic lines. We hope to focus more resources on quality of care, since the Program will not be quite so overwhelmed with quantity.

Resources - Financially, the BIRP operated on \$137,000 USD for the year. The major donor channels were the International Reptile Conservation Foundation (27%), Durrell Wildlife Conservation Trust (24%), and local corporate sponsors (18%). The National Trust for the Cayman Islands (BIRP's parent organization) assisted with warden salaries for several months. Sales and general donations comprised 12% of the budget, and a small grant from the International Iguana Foundation contributed a further 6%.

Matching that, we have been making very heavy use of local and international volunteers. The local press has been giving us brilliant coverage, IRCF is keeping the news current on our web site, and internationally

we're broken into some big name publications: New Scientist, BBC Wildlife, and the BBC News website. On Christmas Day the Travel Channel will air a story on our Blue Iguana Safari tour.

IRCF continues to help us with merchandise. Bobble-heads were this year's hot item. Also, we are very close now to being able to offer Blue Iguana sponsorships online. Tours are beginning to generate a little income, with potential to make a lot more. The FCCA conference in Grand Cayman gave us an opportunity to bid for business with all the major cruise operators, and we already have seasonally good business from several hotels.

Protected Areas - Finally, the BIRP, the National Trust for the Cayman Islands, and the Cayman Islands Department of Environment are still working on the key issue of securing more protected land. We are currently investigating two parcels, which both include some areas of Crown land. Pending a key meeting with government ministers, which we are trying to schedule, we may be launching a major local and international bid for land purchase funds over the next two years.

Iguana iguana on Grand Cayman - *Iguana iguana* continues to spread as an invasive species on Grand Cayman, where it is becoming viewed as a pest. Thankfully, it has not reached the Sister Isles yet. Local government is paralyzed in any kind of response, because local legislation is out-of-date and fails to distinguish iguana species. Pending passage of a draft National Conservation Law, green iguanas and Blue iguanas are lumped in the same legal state.

Cyclura nubila caymanensis - On the Sister Isles (Cayman Brac and Little Cayman), many years have now passed since Glenn Gerber did a year of studies. That work remains unpublished, and we are long overdue for an updated population and status assessment. Durrell Wildlife is considering funding for Matt Goetz to survey the region in 2007 or 2008.



DOMINICAN REPUBLIC - Rupp

Notes on the Distribution of *Cyclura ricordi* and the Problems Facing the Species. Ernst Rupp, Sixto Inchaustegui, and Yvonne Arias (Grupo Jaragua).

The Ricord's iguana (*Cyclura ricordi*) is endemic to Hispaniola. Its population is divided into two isolated ranges within the southwest of this island. In the Barahona Peninsula the species has been dislodged from its historic natural habitat which consists of flat alluvial plains around the town of Pedernales. It survives in the surrounding marine terraces where it depends on depressions filled with soil ("fondos") for reproduction. Four fondos have been monitored over the last three years for nesting results. A Municipal Protected Area has been created to protect the remnant habitat occupied by the species.

In the Neyba Valley the species is still found in its historically known range which consists of Isla Cabritos and the southern shore of Lago Enriquillo. While Isla Cabritos is within the Enriquillo National Park, the southern shore of the lake does not have any legal protection. Habitat alteration by charcoal production and hunting are threatening the species in this area. In spite of these problems there seems to be ongoing recruitment of hatchlings into the extant population and reproduction does not seem to be limited by ground conditions. High concentrations of dens of Ricord's iguana can be found in dry creek beds. Rare events of naturally occurring floods may represent a real threat to the animals living in these creeks.

A small population of *C. ricordi* has been spotted in a marine terrace near the town of Anse-a-Pitres, Haiti. It is the first report of the species in this country. The population is threatened by extreme habitat alteration due to charcoal production as well as hunting. Despite intensive search during nesting season, no nests have been found and there may be a severe recruitment problem for the species in this area.



TURKS AND CAICOS ISLANDS - Gerber

Turks and Caicos Iguana, 2006 Update. Glenn Gerber, Lee Pagni, and Allison Alberts (Zoological Society of San Diego).

In March 2006, a team from Island Conservation (IC) and CRES (San Diego Zoo's Conservation and Research for Endangered Species) visited the Turks and Caicos Islands (TCI) to conduct a feral mammal assessment of Little Water, Water, and Pine Cays, and investigate the feasibility of eradicating cats and rats from these interconnected islands. In addition to fieldwork, meetings were held with stakeholders for these cays, including the Turks and Caicos National Trust (TCNT), the Department of Environment and Coastal Resources (DECR), the Pine Cay Home Owners Association (HOA), and a representative for the Water Cay development. IC made a second trip to the TCI in April 2006 to make a presentation to the Pine Cay HOA at their annual meeting. The Pine Cay HOA has committed \$50,000 toward the eradication of cats, which is estimated to cost \$155,000. IC also wrote a proposal for submission by the TCNT and DECR to the Turks and Caicos Conservation Fund for an additional \$50,000 for this project, and negotiations are underway with the Water Cay developers to provide the final \$50,000 needed. Feral cat eradication is expected to commence in July 2007. Eradication of rats will be much more expensive and is not currently anticipated. An electronic copy of IC's assessment is available on request.



Culinary fun in Puerto Rico. Photo by John Iverson.

cused on collaborating with local partners at the BVI National Parks Trust to involve the next generation of Anegadians (students) and keeping community members informed of research activities and conservation goals. The next stage of outreach activities will attempt to raise country-wide awareness to the iguanas' conservation status and situation.

As with the TCI project, there has been no over-arching evaluation of the outcomes of our education evidence. Anecdotal evidence suggests that there is a greater awareness of the intricacies of the restoration project and support for conservation and research activities.

I would like to thank all my collaborators at the following institutions whose efforts continue to improve our outreach activities for the Anegada iguana: BVI National Parks Trust, Dallas Zoo, Fort Worth Zoo, International Reptile Conservation Foundation, International Iguana Foundation, Virgin Island Network of Environmental Educators (VINE), and the Zoological Society of San Diego's Conservation and Research for Endangered Species (CRES) and Education Department.

***Cyclura* Studbook**

Tandora Grant (San Diego Zoo, CRES)

A preliminary genetic and demographic analysis of captive and free-ranging populations of Grand Cayman Blue Iguanas was presented.

In the US, a total of 30 animals representing 12 founders are housed in breeding situations at 12 zoological institutions. The number of represented founders has increased from eight since 2002. In Grand Cayman, there are 136 animals in the captive breeding population with an additional 61 being headstarted from QEII Botanic Park nests. We have 15 founders in GC with five potential founders. The breeding success of this population has significantly increased genetic diversity from 88% up to 94.4% since 2002.

A total of 62 animals, representing 11 founders, have been released to the semi-protected QEII Botanic Park since the late-90s. Since then, three have been verifiably killed by dogs, one was stolen, one is residing in the

East End well outside of the Park, and two have been returned to the captive facility. If the remaining 55 animals were all alive and well, the population would consist of animals aged three to eleven (not including rare recruitment success) comprising a genetic diversity of 91.3%. Considering only the 28 animals that were seen in 2005/06, founder representation is still reasonably well-distributed. Four females are to be released which will add a new founder to the Park. Females released in the winter, placed in cozy retreats at night, have a higher likelihood of contributing to the gene pool because of increased site fidelity.

In the last three winters, 205 animals have been released to the Salina Reserve, one of which is known to have died. Most of these releasees were headstarted from QEII Park nests and have 50% known pedigrees (only the dam is certain). This new population ranges from one to four years in age has representation from ten founders. It is hoped that recent genetic analysis by Dr. Stephan Funk, University of Puerto Rico, will improve our knowledge of sire contribution in the QEII Park, which will aid in future release strategies for both locations (see Genetics Working Group Overview above).

**Indianapolis Zoo Reports First Jamaican Iguana Breeding in the United States.**

Richard Reams and Jan Ramer
(Indianapolis Zoological Society)

The Indianapolis Zoo is pleased to report the hatching of several Jamaican iguanas (*Cyclura collei*) in late August and early September of 2006. Two separate females produced 35 eggs, of which 22 hatched. The eggs hatched after approximately 80 days and were incubated at 86 – 88 degrees Fahrenheit. The 22 neonates are currently doing great and are growing fast. Starting at just 22 grams, many now weigh over 200 grams.

Prior to this successful reproduction, there were only 18 specimens in North American zoos. This breeding more than doubles the North American population at 40 iguanas. Most of these genetically valuable animals will be sent to other North American zoos in the near future. This breeding represents the first captive breeding of Jamaican iguanas outside of Jamaica.

Does Education Really Help Conservation? Lessons from Two *Cyclura* Conservation Programs.

Lee Pagni (Zoological Society of San Diego).

The question of whether education should play a role in conservation seems rhetorical. In general, conservationists feel that education is a key component of conservation activities. This is fortunate because obtaining evidence that education programs directly result in conservation action is difficult, time-consuming, and filled with uncertainties. This is not to say that evaluation of programs is unwarranted. In fact, only through evaluation of education programs can we hope to improve their effectiveness.

Since 2000, the Zoological Society of San Diego (ZSSD) has supported outreach activities related to the conservation and research project on the Turks and Caicos iguana (*Cyclura carinata*). These activities have taken many forms in order to reach numerous members of several audience categories. In descending order of priority, these audience categories are: locals (adults and children); visitors to the Turks and Caicos Islands (TCI); and other adults and children, including conservation colleagues and ZSSD members and visitors. Outreach activities have included writing articles for local and in-flight magazines, developing education kits for local 5-8 grade students, posting project information on ZSSD and other websites, holding capacity building workshops for TCI colleagues, giving presentations to local and international colleagues, creating a series of posters regarding the project, and producing informational signs to be posted on offshore islands.

Several types of evaluation tools have been used to help design and measure the effectiveness of these programs. One tool, a simple matrix, allows us to see which audiences we are reaching with which messages using which media.

Other evaluation tools have included needs assessments, pre/post testing to measure changes in knowledge and attitude from programs, and formative evaluations to help improve materials such as

the education kits. Although there has been no overall program evaluation, anecdotal evidence has elucidated a couple important points.

1. Education programs take time to become effective. We began to notice a greater awareness of our conservation, research, and outreach efforts after two to three years.

2. Utilizing a variety of media helps reach more audience members. This is not a unique finding. This does however confirm the importance of promoting a consistent message across various media to reach the most people.

Significant outreach programs for the Anegada iguana (*Cyclura pinguis*) restoration program began in 2003, concurrent with the first releases of headstarted iguanas. Since then, the number of people who know about and are interested in the program has increased each year. A highly successful example of the outreach program is the local involvement in the annual release of headstarted iguanas. In 2003, approximately four people from the BVI were involved in the releases. In 2006, this number grew to over 40 individuals. Although the releases are an obvious opportunity for holding a public event, the interest in participation indicates that creating public events around conservation activities can help increase awareness and support among the local community.

Because of the small size of the local population (estimated between 100-200 people), outreach activities have been less intense in Anegada than those in the Turks and Caicos Islands. Instead, activities have fo-

EDUCATION MESSAGE	"We are working to protect the iguanas."	"Do not bring your cats to the cays" (i.e. how to help).	"The results of our research show..."
Audience			
Local Adults	✓	✓	✓
Local Children	✓	✓	
Visitors	✓		✓
Scientists	✓		✓
Other Adults	✓		✓
Other Children	✓		✓
Medium	<ul style="list-style-type: none"> ◦ Magazine articles ◦ ISG meeting ◦ Websites ◦ Local workshops ◦ Education kits 	<ul style="list-style-type: none"> ◦ Signage ◦ Education kits ◦ Magazine articles 	<ul style="list-style-type: none"> ◦ Magazine articles ◦ ISG meeting ◦ Websites ◦ Local workshops ◦ Education materials

Fig. 1: Outreach activities matrix for Turks and Caicos rock iguana.

A collaborative genetic study examining the subspecific status of the Booby Cay population of *C. carinata* in the Bahamas was completed and submitted for publication. Five mtDNA haplotypes at the ND4 locus were identified for populations within the TCI and the Booby Cay population was found to be fixed for the most common of these haplotypes. Based on this finding, and the lack of significant morphological variation between Booby Cay and TCI populations, we propose sinking the subspecies *C. carinata bartschi*.

Several educational projects were completed in 2006, including the production of six traveling conservation awareness kits for TCI primary schools, and a set of three graphic panels for the new TCI National Environmental Center that describe the iguana conservation and research program. In addition, we wrote our third popular article on iguana conservation and research for the popular in-flight magazine, Discover Turks and Caicos.

Two used 190 horsepower diesel engines were purchased for the TCI-based research vessel, Cyclura, and installation of these engines, as well as other needed upgrades and repairs, will be completed in early 2007. A research trip is planned for March/April 2007 to monitor iguana populations translocated in 2002/2003, and conduct surveys of iguana populations on Little Water, Water, and Pine Cays to provide baseline data prior to cat eradication. To safeguard the existing iguana populations on Little Water, Water, and Pine Cays during the cat eradication process, an ISG representative will be on site when the project commences to verify that iguanas are not being harmed and to help modify methods if needed.

Establishment of the non-profit Caribbean Wildlife Foundation (CWF) in the TCI is underway, awaiting completion of articles of incorporation and bylaws. This will be followed by transfer of ownership for the Cyclura, its tender, and associated research equipment, to the CWF from the Zoological Society of San Diego. The CWF will be run by a three-member board (initially) and its mission will be the preservation of biodiversity in the wider Caribbean region.



Jamaican Iguana Recovery Project, 2006 Update.
Byron Wilson and Rick Van Veen (University of the West Indies).

2006 was a very productive year for the project, but was also one that presented some serious challenges to our capacity and resolve. In particular, illegal tree cutters encroached into the "core" iguana area and brought habitat destruction and security issues to the forefront of our concerns. Field assistance was provided by Dawn Fleuchaus, Leon Samson, Brian and Stephanie Wicker, Rhonda Pike, Tom Biltoft, and University of the West Indies students. Mark Gold, our superlative boatman and field companion, continued to provide safe and reliable transport, as well as help with land-based aspects of the field effort. Funding was provided by grants from Conservation International, the Disney Wildlife Conservation Trust, the International Iguana Foundation, the International Reptile Conservation Foundation, and by a New Initiative grant from the University of the West Indies, Mona.

New Iguana Conservationist – A most exciting development for the project has been the addition of a talented and highly reliable field worker in the form of Leon Samson. With close ties to the Port Royal Marine Laboratory (the UWI Life Sciences facility that provides boat transport for the project), Leon joined the recovery effort in January of 2006. With funding from UWI New Initiative and Conservation International grants to Byron Wilson, Leon has been making a significant contribution to our efforts. Training of Leon to assume additional field duties is on-going. This training, together with his high level of enthusiasm, should translate into a long-term project member who will ultimately take over the reins of field coordinator from Rick van Veen.

South Camp Renovations - Having completed a major post-Hurricane Ivan reconstruction of our field station, further improvements to "South Camp" have been on-going. In 2006, the team constructed two large wooden platforms to serve as bases for tents, which increases the field worker capacity of South Camp. Other improvements included the acquisition of four deep-cycle batteries, additional electrical components, and the subsequent establishment of a functioning

wind generator for supplying power to camp. A two-burner gas stove was obtained for a dramatically remodeled kitchen and additional cement work was also completed.

Habitat Protection Advocacy and Support - One positive development is that management capacity for the Hellshire Hills may finally become a reality. The National Environment and Planning Agency (NEPA) has apparently delegated management authority to the Urban Development Corporation (UDC). Encouragingly, the first ever “no tree cutting” signs were posted along the periphery of Hellshire in the vicinity of Hillrun and Coquar Bay. Significantly, the UDC has hired a new Environmentalist and new Environmental Officer whose work will focus on the implementation of the UDC’s Hellshire Environmental Management Plan (HEMP).

2006 Nesting Season - The two main nesting areas in central Hellshire (“Upper Nesting Site” [UNS] and “Lower Nesting Site” [LNS]) were monitored from newly constructed observation hides during the month of June. In total, 13 females were confirmed as having deposited nests in these two areas. These communal nesting areas were surrounded with metal flashing prior to the hatching season in September and resulted in the collection and enumeration of over 100 hatchlings. Several other successful nests were also discovered during the hatching season. 14 hatchlings emerged from a secondary nest near the LNS, and a minimum of six hatchlings (1 + 5) emerged from two small “rock-hole” nests. Another rock-hole nest southwest of the main nesting areas was also discovered, but this nest was flooded by heavy rains, as it had been in 2005. One other potential rock-hole nest was noted but was not accessible and therefore could not be examined to determine whether it produced hatchlings. Finally, “Stumpy”, a head-start release from 2001, deposited eggs in the camp vegetable garden; these eggs did not hatch. Overall, there was a likely minimum of 21 potentially successful nests and 23 nesting attempts.

In total, we documented the successful production of 125 hatchlings. 85 were PIT-tagged and released, 20 were taken to the Hope Zoo for head-starting, while the remainder were enumerated based on the discovery of hatched eggs.

Radiotelemetry - Starting from the nesting season, Rick van Veen began attaching small (BP-2) radio transmitters to post-partum female iguanas and other adult or subadult animals. The main objectives of the exercise were to determine the distances females were traveling to access the two known, communal nesting areas, to map their non-nesting season home ranges, and to gather additional information on habitat use patterns. In total, 15 females and 11 males were radio-tagged. Several of the transmitters failed almost immediately, or became detached from the lizard. In all, reliable data were obtained for 20 animals. As expected, females have smaller home ranges than males, but somewhat surprisingly, these females apparently live quite close to the nesting areas. We had expected that given the paucity of suitable nesting sites (i.e., dirt areas), some of them would have traveled considerable distances.

This study has revealed some interesting aspects of iguana behavior and habitat use that may have important conservation implications. For example, well-worn iguana trails (“pads”) leading to and from particular fruiting trees were noted during radiotelemetry efforts. These pads appear to have been used by iguanas for decades (or longer), and point to the critical importance of these resources. This, of course, underscores the imperative of curtailing tree cutting in the Hellshire Hills.

Population Inferences - During the course of live-trapping iguanas to obtain subjects for the telemetry study, a total of 34 adult or subadult animals were captured. Of those, nine were previously PIT-tagged wild adults, four were “new” wild subadults or young adults, and 21 were headstarters. Hence, 62% of the trapped sample were headstarters, further suggesting the importance of headstarting/augmentation to the remnant population residing in the very central part of the iguana area.

Pitfall Trapping Experiment - This field experiment, examining the impact of mongoose control on the terrestrial herpetofauna of the Hellshire Hills, proceeded into its tenth year. Although we have not seen the increase in ground reptile abundance that was anticipated, this long-term trapping exercise represents a novel monitoring program for a Caribbean dry forest, and certainly represents the most useful gauge of biotic patterns within the Hellshire Hills.

collect specimens of this genus from throughout their range with collections to begin summer 2007. Collaborators working in the southwest of North America willing to collaborate on collections and research projects are being sought.

Sauromalus varius [Rex McAliley] - Following listing of *S. varius* as an Endangered species, a captive breeding program was initiated in an effort to remediate the decline of this species. McAliley will continue to monitor the genetic diversity of individuals in this program in an effort to provide data for the continued successful management for this colony. He is also working to obtain permits to continue work on this species on Isla San Esteban to determine population structure, breeding structure, and population status in the wild. Collecting of samples continues to be a problem and anyone working in this area would be welcome to collaborate.

IGUANA

Phylogeographic History of *Iguana iguana* [Catherine Stephen] - Nuclear and mitochondrial haplotypes across the entire range of *Iguana iguana* are being collected to examine the phylogeographic history of this species. Results from both data sets show a congruent, deep lineage divergence between the Central American populations and the South American plus Lesser Antilles populations of green iguana. A related manuscript should be submitted in the summer of 2007.

Population Genetics of St. Lucia Iguana [Stephan Funk] - Pending the development of microsatellite primers, we will investigate the connectivity between the main distribution areas of iguanas in St. Lucia. Additionally, the data will be used to investigate reproductive structure.



General Reports

A Model for Protecting Island Ecosystems Using Integrated Regional Conservation Programs.

Brad Keitt (*Island Conservation*).

Introduced mammals are one of the greatest threats to island ecosystems. This is because most island ecosystems historically lacked mammalian predators and herbivores and therefore many islands’ flora and fauna lack defenses necessary to compete against these invasions. Removing introduced mammals from islands can protect island ecosystems, and we believe this can be done effectively by regional island conservation organizations that integrate: 1) applied research and priority setting; 2) public education and policy work; 3) capacity building; 4) conservation action; and 5) monitoring and evaluation.

In Northwest Mexico we developed such an organization to protect the region’s 230+ islands. These islands have 26 species of breeding seabirds and over 210 species and subspecies of endemic vertebrates. Non-native mammals have been introduced to at least 44 islands and are responsible for the probable extinction of 21 endemic vertebrate species and subspecies. Island Conservation, the Universidad Nacional Autonoma de Mexico, Centro de Investigaciones Biologicas del Noroeste, and the Mexican National Protected Areas Department collaborated with local people and NGO’s to remove one or more introduced mammals from 25 islands. This integrated model for the conservation of island species is exportable to other parts of the world. Given that *Cyclura* iguanas are especially susceptible to introduced mammals, the development of a program to remove introduced mammals from *Cyclura* range islands in the Caribbean is an important part of their conservation.



Ctenosaura similis Phylogeography [Stesha Pasachnik, Victor Reynoso, Larry Buckley] - This is an in-depth look at the variation within *C. similis* throughout its range. This will consist of sequencing samples that have already been obtained in Panama and Honduras as well as continuing to sample from other parts of the range. Pasachnik is in the process of obtaining permits to collect DNA samples from Guatemala and Reynoso will be collecting samples from Mexico. For laboratory work, Reynoso, Buckley, and Pasachnik will all collaborate in the data collection and analysis.

Phylogeography of the *C. pectinata/acanthura* Complex [Victor Reynoso, Larry Buckley] - Phylogeographic surveys of populations of both *C. pectinata* and *C. acanthura* confirms that *C. pectinata* is paraphyletic. Systematics and phylogeography work will likely result in the recognition of additional species within this clade. Comparative morphological and molecular work is continuing to establish the geographic limits of monophyletic groups within *C. pectinata* that warrant recognition as full species. Reynoso and Zarza will look in detail at the distribution of the genetic and morphological variation throughout the range of *C. pectinata* and *C. acanthura*, with detailed collection of several specimens from localities closely separated. The mitochondrial and nuclear markers to be used are ND4, Cyt-B, Alpha enolase and OD. Buckley will be using other loci to examine the relationships among recovered monophyletic groups within the clade and identify those requiring specific recognition using Cyt-B, Rhod, 12s/16s, Bfib.

Systematics of *Ctenosaura hemilopha/macrolopha* [Victor Reynoso] - Reynoso and Zarza are inferring the genetic relationships between the different species of the *C. hemilopha* complex based on genetic information (ND4, Cyt-B, Alpha enolase, OD genes) and exhaustive sampling across its distribution range including insular areas. The validity of suggested species and subspecies is being evaluated.

Phylogeography of *Ctenosaura oaxacana* [Victor Reynoso] - Reynoso and Zarza using ND4, Cyt-B, Alpha enolase and OD, will evaluate the distribution of genetic variation within *C. oaxacana* and its relationship to *C. quinquecarinata*, through out its distribution range including a series of new recently found localities.

Phylogeography of *Ctenosaura clarkii* [Victor Reynoso] - Reynoso, Zarza, and Quijada will evaluate the distribution of the genes ND4, Cyt-B, Alpha enolase, and OD in *C. clarkii*, and its relationship to *C. quinquecarinata* through out its distribution range. This work is in the beginning stages.

Contact Zones Between *Ctenosaura* Species [Victor Reynoso] - Zarza and Reynoso, using ND4, Alpha enolase and microsatellites, will evaluate the genetic dynamics of the contact zone of *C. pectinata* and *C. hemilopha*. As well, Reynoso, Zarza and Romero will study the dynamics between *C. pectinata*, *C. acanthura*, and *C. similis*.

Hybridization Between *Ctenosaura similis* and *Ctenosaura bakeri* [Stesha Pasachnik] - This is a study of the possible of hybridization between *C. bakeri* and *C. similis* on the island of Utila. At this point we are not seeing a large amount of evidence for hybridization using ND4, Cyt-B, LDHA, and PACs. Additional markers, techniques, and/or analysis may be used to continue to examine this possibility.

Phylogenetic Analysis of *Ctenosaura melanosterna* Complex [Stesha Pasachnik] - Phylogenetic analysis of the entire *C. melanosterna* complex (*melanosterna/palearis/loedirbinal/bakeri*) is being undertaken using DNA sequence data and using other molecular techniques. Permits have been obtained to collect DNA from *C. palearis* in Guatemala and will continue with collections in Honduras. This summer Pasachnik will spend three months collecting samples which should complete the field work for this project. Special attention will be given to *C. melanosterna* in collaboration with Dr. Chad Montgomery who has recently become interested in comparing populations of *C. melanosterna* on Cayos Cochinos using microsatellites. Pasachnik will extend this project by including her data from the mainland.

SAUROMALUS

Broader Systematics of *Sauromalus* [Rex McAliley] - McAliley in collaboration with others (as yet unidentified) will be working to determine the status of the species of *Sauromalus*. This group continues to be troublesome in recognition of species status for many populations and verification of this status is a priority. McAliley is currently working to obtain permits to

Predator Control - We continued to operate and expand upon our predator trapping program in 2006. Trapping capacity was enhanced by the addition of 30 new mongoose/cat traps and 120 new snares obtained through a grant to the pig project being conducted by Professor R. Robinson and the iguana team. Numbers of invasive predators caught and removed were similar to previous years: around 100 mongooses, half a dozen cats, and over 30 pigs. Also removed were substantial numbers of rats and cane toads. No dogs were trapped during 2006 though they were an occasional presence in the forest.

Goat Islands Restoration - As always, interest in a rehabilitation program for the Goat Islands has been high, but awaits higher level management activity before it can become a reality. At present, the UDC is (should be) working on the development of an MOU with Durrel Wildlife Conservation Trust which is a necessary prerequisite for DWCT to embark on a fund raising campaign to fund the implementation the restoration effort. In addition to continuing interest from the IUCN-ISG and the IIF, Island Conservation has also expressed an interest in participating in the eradications of invasive species on the Goat Islands.

Tree Cutting Crisis - In November 2005, we discovered cut lignum vitae trees well within the "core" iguana conservation zone. Occasional incursions continued until October 2006, during which lignum were cut within 150 metres of the Lower Nest Site. Ground reconnaissance revealed that the incursions were emanating from a trail ~100 meters west of our historical trail (at the Dread's old place). Large commercial charcoal operations were also noted within the iguana area and a subsequent Jamaica Defense Forcer helicopter trip confirmed both the extent of charcoal operations in central Hellshire and their proximity to our research and conservation activities.

Police operations also resulted in the confiscation of charcoal, both in the vicinity of Hillrun and along the coast. One arrest was apparently made at a charcoal burning site east of Manatee Bay; it is unclear what level of legal action was taken against coal burners along the northern edge of Hellshire. Unfortunately, the public education program to be launched by the UDC lagged behind police activities, and rumours of coal burner anger directed at iguana researchers have

emerged. Armed police escorts have been used in special cases, but it is not practical to have iguana workers accompanied by the police during every activity. Accordingly, we are now continuing activities as before, albeit with a heightened sense of unease. Should these security problems remain unaddressed, or worsen, the viability of the iguana recovery effort must certainly be viewed as tenuous.

Residential and Tourism Development - The UDC has revised their original plans for residential expansion in the Hellshire area. Old plans for a large development in the central Hellshire area have apparently been shelved; at present, on-going and future development will be limited to the eastern portion of the peninsula, adjacent to existing development in the vicinity of the Hellshire Beach community. These new plans provide for the protection of most of the remaining Hellshire forest, including what we consider to be the core iguana area in central Hellshire. However, a densely populated community located deeper into Hellshire, with an increase in human and other species incursions (especially dogs and cats) is of concern.

A more insidious threat is the potential for tourism interests to overwhelm conservation concerns and result in the construction of large hotels along Hellshire's remaining white sand beaches. Make no mistake about it, local and foreign development interests have turned their eyes on every undeveloped beach remaining on the island. The combination of government ineptitude, personal greed, and the temptation of foreign investment has already proved disastrous in Jamaica. The general pattern is as follows: a foreign entity pledges support, political will overrides the country's environmental legislation, the project starts without a proper EIA, ground is broken and suddenly hundreds of new workers are employed. Because taking jobs away from desperately poor people is something that "can't be done," the project then attains a momentum that is impossible to halt. Therefore, it is imperative to ensure that these projects never get off the ground.



Anegada Iguana 2006 Conservation and Research Update. Glenn Gerber, Lee Pagni (Zoological Society of San Diego), and Kelly Bradley (Dallas Zoo).

Headstarted Iguana Releases – Twenty-four headstarted Anegada iguanas fitted with radiotransmitters were released in October 2005. As with previous releases in October 2003 and 2004, 12 animals, six males and six females, comprising similar size ranges, were released at each of two sites: Middle Cay with rocky woodland habitat, and Windlass Bight with sandy scrub habitat. In 2005, we continued the trend of releasing slightly smaller animals than the year before, in an attempt to determine the minimum size iguana that can survive with cats. The smallest iguanas released in 2005 were 450g, as opposed to 600g in 2004, and 750g in 2003. Unlike previous releases, where all 24 animals were fitted with internal transmitters, only the eight smallest animals released in 2005 (those between 450 and 600g) received internal transmitters. The largest 16 iguanas were fitted with external transmitters attached to the nuchal crest.

Iguanas released in 2005 were tracked for a total of 15 weeks, over a one-year period (October to October), to monitor their survival, growth, habitat use, behavior, and home range. In addition, iguanas released in 2004 and 2003 continued to be monitored, whenever possible. Despite each year releasing a range of differently sized animals, decreasing the minimum size of released animals, and releasing animals in two very different habitat types, we have observed no differences in survival between years or study sites, one year after release (overall mean = 86% survival), and no associations between animal size and survival.

In October 2006, the fourth annual release of iguanas took place. All animals in the headstart facility that weighed 450g or more (29 individuals) were released, bringing the total count for animals released since 2003 to 101. 2006 was the first year animals were released without radio-transmitters. Based on previous work, we feel confident these animals will experience survival rates similar to prior release groups. Of the 29 iguanas released, 15 were released at Windlass Bight and 14 at Middle Cay. Sex ratios and size ranges of released animals were balanced between the two sites, as with earlier releases.

Health Screening – In October 2006, a veterinary team from the Wildlife Conservation Society (Robert Moore and Kate McClave) performed prerelease health screens on iguanas at the headstart facility. All of the animals slated for release were found to be in good physical condition with acceptable blood chemistry and hematology profiles.

Feral Mammals – In March 2006, a team from Island Conservation (Brad Keitt and Bill Wood) and CRES visited the British Virgin Islands (BVI) to conduct a feral mammal assessment of Anegada and investigate the feasibility and cost of eradicating cats, livestock, and rats from the island. In addition to fieldwork, meetings were held with local stakeholders, including representatives from the BVI National Parks Trust (NPT), the Conservation and Fisheries Department, and the Agriculture Department. Island Conservation's recommendation is to first eradicate feral cats and livestock. Eradication of rats will be much more expensive and is not currently a priority. An electronic copy of Island Conservation's assessment for Anegada is available on request.

Nests and Hatchlings – During the first half of July 2006, a team of five volunteers (Joe Burgess, George Waters, Tina Bouse, and Todd and Kym Campbell) traveled to Anegada to help with the annual nest search and other fieldwork. Four nests were located: one at Cooper Rock on the northeast shore, and three at Windlass Bight along the north-central coast in the core iguana area. As in years past, temperature data-loggers were placed in each nest, and a fence of metal flashing was erected around each nest site to contain the hatchlings upon emergence and exclude feral mammals.

In October, hatchlings emerged and were collected from each of the four nests found in July. The number of hatchlings emerging from individual nests was 14 for the Cooper Rock nest, and nine, nine, and six for the Windlass Bight nests. Despite attempts to excavate all nest sites after emergence, only the egg chamber for the Cooper Rock nest could be located. It contained 14 empty eggshells (100% hatch rate). In addition to recovering 37 of the 38 hatchlings known to have emerged from our four marked nests, an additional five hatchlings were captured during the course of other fieldwork and one hatchling was captured in the Settlement, bringing the number of hatchlings placed in the headstart facility to 43 this year.

Genetics Working Group Overview

Below is a summary of ongoing genetic projects of those ISG members that attended the 2006 ISG meeting in Puerto Rico, including Catherine Stephen, Larry Buckley, Stephan Funk, Rex McAlilely, Bill Modi, Stesha Pasachnik, and Victor Reynoso. Although there are additional collaborators, names in brackets indicate the main contacts for a particular project.

Broader Iguaninae Phylogenetics [Catherine Stephen, Larry Buckley] - DNA sequence data from multiple nuclear (NT3, C-mos, Rhod) and mtDNA (12/16s rRNA, Cyt-B, ND4) loci are being used to assess the family level relationships between all Iguaninae genera. Genetic data collection is 75% complete. Fieldwork in May 2007 should complete sample collection and remaining genetic data will be collected in June 2007.

CYCLURA

Development of Standardized Microsatellite Primers [Stephan Funk, Bill Modi] - Nearly 75 primer pairs have been developed independently by several laboratories for *Cyclura pinguis*, *Cyclura cychlura*, *Cyclura nubila*, and *Cyclura cornuta*. The extent to which these amplify and identify polymorphism in heterologous species is unclear. Stephan Funk will receive genomic DNAs from several species and primers from *C. pinguis* from CRES and test all 75 primer pairs on all species of *Cyclura* to develop a standardized panel of markers that will be available to the public.

Distribution of Variation Within Three Species Affected by Natural and Human Induced Bottlenecks [Bill Modi, Glenn Gerber, Charles Knapp, John Iverson, Catherine Stephen] - Glenn Gerber has collected 800 blood samples of *Cyclura carinata* and 250 of *Cyclura pinguis*; Chuck Knapp has collected 135 DNA samples of *Cyclura cychlura*. Chuck Knapp and John Iverson are active in the field and plan to collect 300 more samples from this species. We are on schedule to submit an NSF proposal this July to try to obtain funding to assess variation at 25 microsatellite loci on a subset of these samples. We will focus on populations for which 20 or more individuals are available for any given island. Data will be used to examine levels of within and between island variation of each species and assess the effects of historical and human induced bottlenecks on populations.

Population Genetics of *Cyclura cornuta stejnegeri* [Keysas Rosas, Stephan Funk] - Rosas is completing her graduate work on *C.c. stejnegeri*. She is collecting microsatellite data on the subspecies. Particular issues that will be addressed in this study include: multiple paternity, social organization and reproductive success, geographic structure of relatedness, and estimates of recent and historic demography.

Phylogeography of *Cyclura cornuta* [Catherine Stephen, Stephan Funk, Jan Ramer] - This study will use microsatellite and DNA sequence data to assess the connectivity between populations of *C. cornuta* within the Dominican Republic and attempt to identify the source population for those on Mona Island. Additionally, we will compare levels of variation on the mainland to the island population.

Population Genetics of the Magueyes Iguanas [Stephan Funk] - Funk is conducting microsatellite analysis to analyze relatedness and identify population origin (using ASD and multidimensional scaling, etc).

Conservation Genetics of *Cyclura pinguis* [Oliver Ryder, Glenn Gerber, Bill Modi] - A large microsatellite loci panel has been developed for *C. pinguis*. In the summer of 2007 a new student will begin work at CRES on the population genetics of *C. pinguis* to assess levels of diversity in the wild population compared to cohorts of headstarted individuals.

Captive Breeding Genetics of *Cyclura lewisi* [Stephan Funk, Fred Burton] - Genetic data will be collected to quantify variation in the captive and wild population. This information will be used to guide captive breeding and headstarting efforts.

Systematics of *Cyclura carinata bartschi* [Catherine Stephen, Glenn Gerber] - A systematic study of the Booby Cay iguana (*C.c. bartschi*) was completed Spring of 2006 and is currently in press at the journal Copeia. The results of mtDNA sequence analysis do not support the subspecies designation.

CTENOSAURA

Phylogeographic History of *Ctenosaura* [Larry Buckley, Victor Reynoso] - Nuclear DNA and mtDNA sequence data are currently being collected in order to establish the phylogenetic relationships between the species of *Ctenosaura* and to examine their current distributions in relation to the geographic history of Central America.

Genetics Session

Update on Iguaninae phylogeography and phylogenetics. Catherine Stephen (Utah Valley State College).

Iguana Phylogeography - *Iguana* consists of two species, *I. iguana* and *I. delicatissima*. While *I. delicatissima* historically has a very limited range restricted to the Lesser Antilles, *I. iguana* is found throughout the Neotropics and the Lesser Antilles. (Burghart & Rand 1982). It seems highly unlikely that *I. iguana* constitutes a single interbreeding population, given the enormous physical distances and barriers to gene flow. We are using nuclear and mitochondrial DNA sequence data to explore the phylogeographic history of this species. Samples included in the preliminary analysis have been collected from 17 different countries. Results from both data sets show a congruent, deep lineage divergence between the Central American populations and the South American plus Lesser Antilles populations of green iguana. The topology of the phylogeny indicates that *Iguana iguana* arose on the South American continent.

Iguaninae Subfamily Phylogenetics - Iguaninae is an ancient group with eight modern genera distributed throughout the Western Hemisphere and in the Fijian archipelago. Previous morphological and molecular studies of Iguaninae relationships have relied on incomplete sample sets that yield conflicting topologies. The subfamily collectively spans thousands of miles across multiple geographical boundaries, and exhibits a high degree of regional and island endemism. Because of its age and distribution, the group is uniquely suited to test biogeographic hypotheses, such as suggested occurrences of past refugia or relictual fragments, as well as allowing empirical evaluation of molecular clock models. In order to generate a robust phylogeny we have collected DNA sequence data at four loci (two nuclear and two mitochondrial) for all eight genera, including 28 of the Iguaninae species. Phylogenies generated from maximum likelihood analysis of separate data sets result in congruent phylogenies with varying levels of resolution. Preliminary analysis strongly supports

Dipsosaurus as the most basal lineage in the subfamily followed by an early dispersal of *Brachylophus* to the Fijian Archipelago and a subsequent divergence of the *Cyclura* lineage. A sister relationship between *Sauromalus* and *Iguana* is supported by the combined analysis and this clade is sister group to the rest of the subfamily (*Ctenosaur*, *Amblyrhynchus*, and *Conolophus*). Interestingly, *Ctenosaur defensor* falls outside of the *Ctenosaur* clade in the three data sets in which it is included.



Using Coalescent-Based Analyses of Multilocus Microsatellite Data to Estimate the Past and Recent Population Histories of Three Species of Caribbean Rock Iguanas. William Modi, Glenn Gerber, Charles Knapp, Jennie Lau, Maggie Reinbold, Leona Chemnick, Oliver Ryder (Zoological Society of San Diego), Peter Andolfatto (Univ. of California, San Diego), and Catherine Stephen (Utah Valley State College).

Although the significance of recent anthropogenic activity on the census sizes of insular populations is relatively easy to determine, the concomitant impact on genetic diversity is less obvious. Assessing genetic diversity is important for predicting the future fitness and long-term survival of endangered species. The genetic architecture of most species has been molded by population contraction and/or expansion following historical climatic changes, and this tends to obscure the effects of more recent, human mediated activity. However, the development of Bayesian computational methods allow for sophisticated statistical modeling of population histories. Specifically, coalescent simulations can calculate the likelihood of observed data under the stationary distribution of a specific demographic model. If the influence of recent anthropogenic events has been significant enough, it can be teased apart from earlier paleoclimatic effects. Four events have potentially influenced iguana populations: last glacial maximum (15,000 years ago), first humans (4,000 years), arrival of Europeans (500 years), modern society and domestic animals (50 years). Microsatellite data for *Cyclura pinguis* (133 individuals, 23 loci) are currently being analyzed. Additionally, 600 DNA samples are available each for *Cyclura cychlura* and *Cyclura carinata*, from over 50 islands, and will be genotyped in the near future.



Headstart Facility - The Anegada headstart facility, maintained and operated by the BVINPT, presently consists of 12 large cages with 66 iguanas (41 hatchlings collected in October, and 25 older juveniles weighing less than 450g) housed in groups of similarly sized individuals. In addition, 29 animals weighing greater than 450g were released in October, as described above. There have been four documented deaths at the facility in the past year. However, two of these were animals with extenuating conditions: one animal from the 2005 hatch with severe spinal deformities and a 2006 hatchling from the Settlement that sustained considerable injury to its tympanum before being brought to the facility. Growth of animals in the facility, including the 29 iguanas released in October, was generally good and showed considerable improvement in the last six months. This is attributed to improved care by facility staff (Alex Varlack, Michael Young, and Rondel Smith) and the addition of Samantha Addinall, with prior experience at the iguana facility on Grand Cayman, to oversee operations on Anegada for the BVINPT. In the coming year, the BVINPT hopes to improve the headstart facility by adding 56 smaller cages (to begin housing animals individually) and constructing a building with facilities for food preparation, equipment storage, and office space.

Genetics - In 2006, in addition to the routine collection of blood samples from all new captures on Anegada (n = 47), blood sampling materials and protocols were shared with researchers on Guana Island. As a result, 29 samples from the translocated population on Guana (founded by eight adults from Anegada between 1984 and 1986), and five samples from the translocated population on Necker (founded by four offspring from Guana in 1995), were added to our sample collection for the species.

Vitamin D Study - In an effort to fill gaps of our knowledge of baseline physiological values, we initiated a new blood chemistry study this year. We collected blood samples to measure serum 25-hydroxy-vitamin D3 (25-OH-D3), calcium, and parathyroid hormone (PTH) concentrations in wild, released, and captive iguanas throughout the year. We collected 20 samples each month for May, July, and October. By taking serial samples, we hope to demonstrate seasonal changes in these variables over time. Bill Gehrman and Gary Ferguson, from Texas Christian University, and Michael

Holick, from Boston University of Medicine, are participating in this study.

Education - Thanks in part to the IRCE, several educational projects were completed in 2006, including the production of laminated headstart facility guides, and 500 posters and 1000 brochures promoting Anegada, its native wildlife, and the iguana conservation and research program. In addition, together with our partners at the BVI National Parks Trust, a hands-on educational program for the public was held in conjunction with the release of headstarted iguanas in October. Participants included Anegada school children and their teachers, ecology students and instructors from Stout Community College on Tortola, and adult residents of Anegada.

New Field Initiatives - In July, with the help of our volunteer field team, we began a new initiative to put permanent ID markers at all known retreat sites, and collect spatial and ecological data for these sites using a data-logging differential GPS. This work was continued in October and we presently have over 100 retreats mapped and marked in the core iguana area. We will continue this work in 2007 and anticipate mapping and marking at least another 50 retreats.

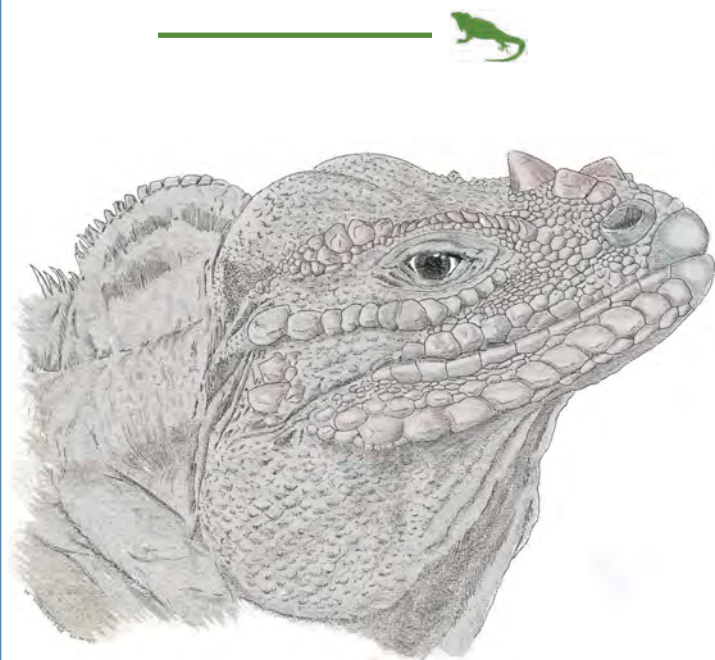
We are also beginning a trapping program to capture, measure, and mark as many wild iguanas on Anegada as possible, in an effort to better estimate population size and other demographic parameters. We experienced good success using live-traps to recapture released headstarted iguanas during the past year and also trapped a handful of wild adults in the process. We now have 14 live-traps on Anegada and in 2007 will begin a concentrated trapping effort focused on the wild population, by systematically trapping animals associated with marked retreats.

In May 2007, we plan to begin attaching two-year external radio-transmitters to adult male and female iguanas at our Windlass Bight and Middle Cay study sites, to determine home range and movement patterns of resident adults in these areas and for comparison to our radio-telemetry studies of released headstarted iguanas at these sites. In addition, as opportunities arise, we hope to use radio-telemetry to track: 1) females leaving coastal nesting sites and returning to their territories; 2) juveniles dispersing from Windberg Cay, a

small islet in Red Pond that appears to serve as a natural headstart facility; and 3) the movements and survival of hatchlings following emergence from nests. Anyone interested in assisting with fieldwork on Anegada should contact Glenn Gerber.

Funding – In July 2006, CRES received a two-year grant of 70,000 Euros from the Nando Peretti Foundation for the Anegada project. Funds will be used for the new field initiatives outlined above, continuation of fieldwork associated with the headstart and release program, educational needs, and the construction of additional cages at the headstart facility. In addition, \$3,000 from Henry Jarecki (the owner of Guana Island) and \$1,000 from Gad Perry (Texas Tech University) have been pledged to CRES for the analysis of DNA samples from the Guana and Necker iguana populations.

Anegada SRP – The Anegada Species Recovery Plan, originally drafted in 2004, has been finalized and submitted for layout and publication. Copies should be available in early 2007.



Drawings by John Bendon. Mona island iguanas: #37 one of the largest females (right) and #38 (above) the largest known male who lives around the facility kitchen and weighs about nine kilograms. John observes that many females have more elaborate or well developed nose horns and when viewed in profile the horns sit higher up.

MONA ISLAND, PUERTO RICO - Perez

Mona Island Iguana, Various Reports on Ecology, Conservation, and Blindness. Nestor Pérez-Buitrago, Keysa Rosas, Stephan Funk, Miguel Garcia, Alberto Alvarez, and Owen McMillan (University of Puerto Rico and Puerto Rico Department of Natural and Environmental Resources).

The rhinoceros iguana, *Cyclura cornuta cornuta*, is widely distributed throughout Hispaniola (Haiti and Dominican Republic), whereas the Mona iguana, *C.c. stejnegeri*, is endemic to the remote island of Mona (Puerto Rico). Mona is located in a deep-sea channel between Hispaniola and Puerto Rico and there is no evidence of a historic connection of Mona with either Puerto Rico or Hispaniola (Wiewandt & Garcia, 1999). The Mona iguana is characterized by low density compared to *C.c. cornuta* and other *Cyclura* species, and by an age pyramid strongly biased towards large individuals indicating low levels of juvenile recruitment into the breeding population. These two traits have led to the conclusion that the Mona population “is abnormally small” (Wiewandt & Garcia, 1999). In order to investigate the factors determining the demography of Mona iguanas and to strategically plan conservation management, the Center of Applied Tropical Ecology (CREST-CATEC) at the University of Puerto Rico and the Natural Resources Department (DRNA- PR) started an intensive research program in 2003.

Research focuses on three study sites representing three environments (vegetation structure and composition) and different levels of human disturbance (from none to high disturbance). To date, we have captured, measured, sampled, and marked 235 iguanas in the three study areas. Captured animals continue to indicate



impacts and needs a specific conservation effort. For example, northern clades are less threatened than the southern clades, since black iguanas are not eaten in the north as they are in the south. But hatchlings of southern clades have better survival conditions compared to the more extreme conditions in which northern clades live. The study involves a very detailed sampling of several individual black iguanas distributed among more than 50 sites in its distribution range. ND4, Cyt-B, Alpha enolase, and OD DNA sequences will be compared, as well as external morphology.

Simultaneously, Eugenia Zarza-Franco is analyzing the genetic structure of *C. pectinata* and *C. macrolopha* in the contact zone where hybrids have been found. Projects still in progress by our laboratory concern the phylogeography and identity of clades in the *hemilopha-macrolopha* complex and the phylogeography of *C. acanthura* and *C. oaxacana*.

The project “Demography of the Black Iguana” is conducted in the Instituto de Biología, UNAM, as a Bachelor and Master’s thesis by Wendoli Medina-Mantecón under direction of Víctor Reynoso and associated with Ernesto Vega of the Instituto Nacional de Ecología, SEMARNAT, México. This project intends to solve the over-exploitation problem of the black iguana as a food source and establish local management programs based on new demographic models such as Sensibility and Elasticity analyses. It is listed in the Mexican Red List NOM-059-2001 as Threatened and currently hunting is illegal. However, our results suggest that if iguana populations are exploited carefully with certain very well established rules, natural populations can be hunted without decreasing their population size. New precise models testing several management strategies are being developed, and future work will model possible scenarios to promote the best hunting strategy to achieve iguana sustainability.

As an alternative to hunting, the Mexican wildlife agency SEMARNAT, is promoting intensive farm production as the best strategy to maintain black iguanas as a traditional food supply. The project entitled “Growth Plus Digestion Efficiency of *Ctenosaura pectinata*: Effect of Food, Temperature, and Sex” is being developed by Pilar Rueda-Zozaya under the direction of Víctor Hugo Reynoso in association with Germán Mendoza of the Universidad Autónoma Metropolitana, Xochimilco, México. This study intends to estimate the effect of

commercial food, incubation temperature, and sex in the growth and digestion efficiency of the black iguana, by evaluating chicken and rabbit pellets as a low-cost captive food option. Food consumption and digestion variables such as dry matter intake, digestible dry matter intake, neutral detergent fiber intake, digestible neutral detergent fiber intake, dry matter digestibility, neutral detergent fiber digestibility, weight gain, food conversion, and food intake as a percentage of animal mass were estimated. This research has suggested that pellet food can be used successfully in iguana farms.

Report on *Ctenosaura palearis* in Guatemala. John Binns (IRCF).

Ctenosaura palearis, variously known as the Guatemalan black iguana or Paleate Spiny-tailed iguana, is the only member of the *Ctenosaura melanosterna* clade with a distribution area outside of Honduras. Found exclusively in the semi-arid Motagua Valley of Guatemala, the species is listed as Critically Endangered on the IUCN Red List based on the limited size of its home range. Recent investigations reveal that, whereas *C. palearis* was intensively hunted as a protein source in the past in preference to the sympatric *Ctenosaura similis*, the species is now extremely rare in some areas.

The International Reptile Conservation Foundation (IRCF), in partnership with Zootropic and Zoo Atlanta, has initiated Project *Palearis* in order to develop and execute a recovery action plan for *Ctenosaura palearis*. This project will be able to leverage many of the components of Project *Heloderma*, designed to preserve the sympatric Guatemalan Beaded Lizard (*Heloderma horridum charlesbogerti*). Specifically, *C. palearis* will be included in Zootropic’s educational program for *Heloderma*, and will be able to utilize the facility proposed for breeding *H.h. charlesbogerti*.

The IRCF has provided a vehicle and seed money for research investigating the distribution, ecology, and conservation status of *C. palearis* beginning in May 2007. Zootropic’s Daniel Ariano, and University of Guatemala undergraduate student, Paola Coti, will be bead-tagging and re-releasing all animals located. Five males and two females are already under observation at the research site in the Motagua Valley of Guatemala. Thanks to the efforts of Zootropic, *C. palearis* has been granted protection under Guatemalan law and specimens may no longer be exported from the country.

Ctenosaura Session

Evolution of Spiny-tailed Iguanas (Genus *Ctenosaura*): How Identification of Species Groups and their Relationships can Help with Conservation Priorities.

Larry Buckley and Katelyn Pagel (Rochester Institute of Technology) and Oscar Flores Vilella (Instituto de Biología, UNAM, México).

The most diverse group of iguanas (15/37 species) are the spiny-tailed iguanas, genus *Ctenosaura*, with 15 currently recognized and at least two unrecognized species. Members of the genus inhabit primarily lowland (<1200 m) tropical dry and arid forests on both coasts of Mexico and Central America. All species fall within one of seven strongly supported clades (species groups). Clade distributions show a strong geographic component and are associated with well-established biogeographic areas. Closely related species (within species groups) are characterized by allopatry, while sympatry is common among species from divergent clades. The relationships among these clades have been the focus of a study using morphological characters and multiple genetic loci (one mtDNA and two nucDNA) in order to establish the branching topology of their evolution in the region. These results contrast significantly with current morphological interpretations and point to several instances of convergence in commonly used in morphological characters in systematic studies of the genus *Ctenosaura*.



Molecular Analysis of the *C. melanosterna* Clade: Insights into Phylogeography, Speciation, and Conservation. Stesha Pasachnik (University of Tennessee).

The genus *Ctenosaura*, overlapping in range with the Mesoamerican hotspot, exemplifies the hotspots reasoning, brought forth by Myers et al. in 2000, in that it is diverse, is threatened with extinction, and lacks sufficient means of protection. Four of the five critically endangered species of *Ctenosaura* make up the *C. melanosterna* clade, occurring within Honduras and Guatemala. Due to the current status of these species it is imperative that immediate evaluation of this clade

be performed in order to facilitate critical management decision making and direct future research. Preliminary molecular analysis has been performed on the *C. melanosterna* clade and the wide ranging congener, *C. similis*. The results from two mitochondrial markers and three nuclear markers suggest that this clade has gone through rapid speciation resulting in four narrow-range endemics that occur in both insular and continental habitats. Evidence of hybridization between the island endemic, *C. bakeri*, and *C. similis* on Utila has been documented using a single nuclear marker. Additional analysis is needed in order to evaluate the status of each species, date the colonization events associated with these species, and define the degree and direction of introgression that is occurring between *C. bakeri* and *C. similis* on Utila.



Black Iguana Project 2006 Update: Genetics, Demography, and Feeding. Victor Reynoso, Eugenia Zarza-Franco, Wendoli Medina Mantecón, and Pilar Rueda Zozayal (Instituto de Biología, UNAM, México)

Research on black iguanas (*Ctenosaura pectinata*) at the Instituto de Biología, UNAM, México, has been coordinated by Dr. Víctor Hugo Reynoso since 1998. During the last few years three different aspects of the black iguana have been researched: 1) phylogeography and population genetics, 2) demography, and 3) the effect of food, temperature, and sex on growth and digestion efficiency.

Genetics and phylogeography of the black iguana is part of Eugenia Zarza-Franco's Ph.D. project in the Laboratory of Molecular Ecology within the Centre of Ecology, Evolution, and Conservation at the University of East Anglia, UK, with Dr. Brent Emerson. This project intends to evaluate genetic differentiation among populations of *Ctenosaura pectinata* to establish the geographic history using mitochondrial and nuclear DNA. He also aims to understand the species limits, history, structure, and genetic variation to promote country-wide conservation strategies. Until now, *Ctenosaura pectinata* has been considered a single species with a broad distribution, however, our findings have suggested that the species is divided in several well-differentiated genetic clades. Because of the existence of different human cultures along the distribution of the black iguana, each clade is subject to different human

“vision problems” in the population. Nine out of 28 animals captured in 1998-99 appeared to be blind, thus supporting earlier anecdotal reports of “vision problems” (Tim Reichard, Toledo Zoo, personal communication). However, the causes for the condition remain unknown, in particular whether it is based on environmental/climatic factors, nutrition and condition of iguanas, or genetic predisposition.

A total of 42 iguanas were marked with radio transmitters and radio-tracked during the reproductive and non-reproductive seasons. Iguanas occupy home ranges with little-to-no overlap among animals of the same sex, indicating sex-specific territoriality. During the mating period, some females “visit” neighboring males with which they do not interact during the non-reproductive season. During the nesting period, females seek a place for nesting and either go directly to a specific nesting location or visit many potential nesting areas. Females appear to exhibit strong competition for nesting sites in communal nesting areas that are already in use by other females. The maximum travel distance observed was by a young female that visited many nesting areas before reaching the final spot after 12.8 km. Hatch success varied from 55% to 89% during the study period.

In 2003 and 2004, we captured hatchlings either for marking with PIT-tags (N=163) and immediate release or for the headstarting program. So far, only one PIT-tagged hatchling was recaptured between 2005 and 2006. The headstarting program was launched in 1999 and employs the DRNA-PR captive facilities on Mona Island. Hatchlings collected in 1999 and 2000 were released in 2002 and 2003. Hatchlings collected in 2003 and 2004 are awaiting release. In 2003, we implemented an intensive mark-recapture program in order to estimate population density and to quantify survival and growth rates of wild and headstarted iguanas.

We are utilizing molecular genetic tools in order to quantify reproductive success of males and to assess multiple paternity. After testing 20 microsatellite primers developed for Cuban iguanas, *C. nubila*, failed to produce interpretable results (An, et al., 2004), we developed a microsatellite library for the Mona iguana. From 29 primer pairs for Mona iguana specific microsatellite loci, we have optimized 19 primer pairs resulting in scorable genotypes. Ten loci exhibit three or more alleles (range 3 to 16, mean = 5.0) in a subset of 55 adults. The marker set has low prob-

ability of identity and high exclusion power even for highly related individuals, thus the marker set is highly suitable for studies of paternity, social organization, and relatedness. Initial parentage analyses for three nests of one female suggest both single and multiple paternity within clutches of different years, different males between years, and sharing of the same nest site by two or more females. Currently, we are confirming and extending these preliminary results by further genotyping.

The Mona island population is ideal to assess the economic costs, reliability, and precision of different methodologies for the estimation of population size because iguanas have been easily observed during the intensive monitoring of the three study areas over the last years. Direct observations, mark-recapture, and radio-tracking suggest that all resident animals have been individually marked. Using information obtained between 2003 and 2005 (mark-recapture and home-range sizes) as baseline data, we are currently comparing costs (time, man-power, and resources) and density estimates of mark-recapture, distance sampling, non-invasive genetic tagging using fecal samples. In addition, we monitor communal nesting areas during the short hatch season (only three weeks in October) in order to investigate whether the method allows the estimation of population trends. In 2006 we counted 680 hatchling emergence holes in the coastal nesting areas, which comprise ~74% of the suitable areas available for iguana nesting on Mona Island (Haneke, 1995).



ISLA MAGUEYES, PUERTO RICO - Alvarez

Problem Assessment and Control of the Introduced Cuban Iguana (*Cyclura nubila nubila*) on Isla Magueyes. Alberto Álvarez, Néstor Pérez-Buitrago, María Andrade-Núñez, and Miguel García-Bermúdez (University of Puerto Rico and Puerto Rico Department of Natural and Environmental Resources).

The exotic Cuban Iguana (*Cyclura nubila nubila*) was introduced in the mid-1960's to Isla Magueyes (southwest of Puerto Rico), as part of a former zoo exhibition (Rivero 1978). The island (7.2 ha) harbors the facilities of the Department of Marine Sciences - University of Puerto Rico (DMS-UPR), Mayagüez campus. Anecdotal information suggests that the

actual Cuban Iguana population in Magueyes comes from one founding pair (A.R. Lewis, pers. comm.). Christian et al. (1986) estimated the population at 167 individuals (23.2 iguanas/ha). Since then, the population has showed a noticeable increase in densities (55 to 70 iguanas/ha), an effect attributed to a removal program of cats and rats implemented since mid-1990's (López-Ortiz, DNER internal report). The most recent census in November 2005 (López-Ortiz, DNER internal report) estimated the population at 422 individuals. This abnormal iguana abundance has become a nuisance for part of the university community in Magueyes who claims to be frequently harassed and occasionally bitten by iguanas, creating an inadequate environment and posing potential legal implications for DMS. In contrast, other people view the presence of this iguana as having a cultural and sentimental value for Magueyes. This situation motivated the administration of DMS to request DNER action to manage/control or eradicate this population. Several options have been under scrutiny since this request: extirpation (donations to zoos, NGOs, and/or private entities), translocation to other known populations of this species, and eradication as a last resource. *In-situ* activities were also considered such as the destruction of nest areas after ovoposition.

To address this issue, DNER's Division of Wildlife personnel, along with students from UPR Department of Biology (Rio Piedras campus), started a mark-recapture program in June 2006 as an initial effort to expand our knowledge of this population relevant to making appropriate management decisions; an initiative endorsed by the Iguana Specialist Group (IUCN-ISG). This information would be critical from the point of view of the ongoing ecological/genetic processes that this unplanned introduced population is having and how they have changed compared to "normal" *Cyclura* populations. In addition, this group offers a unique opportunity to develop research in processes that, although documented for *Cyclura* iguanas, are relatively difficult to quantify, such as frequency of cannibalism events and the effect of exotic predators on the population and demography of the species on the island. Finally, a major priority of this research is to establish the genetic identity of the population, since its origin is uncertain.

An agreement between DNER and DMS granted a 1.5 yr period (ending in December 2007) to conduct

research on the population before decisions concerning its management are executed. By November 2006 we have collected tissue samples, gathered morphometric data on 135 individuals, plus collected some demographic information. Our plan is focused on two major aspects: 1) ecological research, which includes demography, nesting ecology, and diet; and 2) genetic research aimed to establish the genetic identity of the species and the levels of inbreeding in the population. We are inclined to develop an experimental design to quantify the impact of cats on a high density iguana population. Graduate biology students and sources of funding are being considered to perform the field component of the stated goals, thus helping to accomplish the agreement established by the DNER and DMS.



ALLEN CAYS, BAHAMAS - Iverson

2006 Research Update for *Cyclura cyclura inornata*. John Iverson (Earlham College).

Field work in March (one week) and July (one week) focussed on surveys of islands in the vicinity of the two natural populations on Leaf Cay and U Cay in the Allen Cays (Exumas, Bahamas). We surveyed eight of these cays, and found iguanas on six of them (0.25 to 14 ha); however, reproduction is occurring on only one of those islands. The latter cay had no iguanas present in 1996, but now has a population of over 100 individuals. In July, we confirmed that at least eight females had nested on the cay. Some individuals on at least three of the cays were originally marked on Leaf or U Cay, and subsequently translocated to those cays by humans. We believe that tour boat operators may be relocating aggressive iguanas from the Leaf and U Cay beaches where people are allowed to feed the iguanas. Blood samples were drawn from animals from all islands for a study of the origin of the introductions. Additional survey work is planned for 2007, as well as additional study of the nesting ecology of the iguanas on the two introduced cays. Allen Cays iguanas now occur on at least nine separate islands, although only four of these have substantial, reproducing populations. The total world population has increased from about 150 in 1970 to perhaps 1300 today.



over a year later (i.e. from 2005 to 2006), which bodes well for iguana nest protection.

Trapping data also provides an indication of average inter-trap movement distances and some data on mongoose habitat preferences (e.g. higher captures closer to rivers). This will be analysed in more detail using radiotracking data. Preliminary compositional analysis using fixes and home ranges indicate significant non-random habitat use by mongooses with habitats ranked, from most to least preferred as: riverine > forest > scrub > grazed > sand. These findings will help to guide optimal trap placement in future years.

Capacity Building – To maximize the chances of successfully detecting population trends in the St Lucia iguana, the Forestry Department needs to be able to monitor both Grand Anse and Louvet beaches for 30 days each (10:00 – 16:00) between 1st February and 30th April. There needs to be a minimum of two monitoring days per beach per week during this period. We designated 120 people-days (equivalent to two people per beach over 30 days) for iguana monitoring to assess the Forestry Department's capacity to conduct such a monitoring program. We used three measures of success in achieving this objective: 1) attendance showed a marked improvement compared with attendance in 2005, although it still fell short of our objective; 2) time-keeping was less successful, particularly at the Louvet site and needs to be addressed as it will compromise the future chances of the monitoring program's success; and 3) count performance was to a high, consistent standard. This capacity now clearly exists within the Forestry Department. A number of recommendations were made. It should be remembered that impending development at Louvet (see above) may require monitoring protocols to be re-assessed. Durrell has developed a proposal to pilot an alternative baseline (using occupancy probability) in 2007 to address this.

Awareness Raising - Community and one-to-one meetings, television broadcasts including "jingles" in ad slots, and a documentary produced by the Ministry of Agriculture on wildlife conservation which was presented from Louvet and Grand Anse by contestants in the Miss Earth beauty pageant, were all used to raise awareness of iguana conservation issues, in particular the threat from uncontrolled dogs at nesting sites.



FIJI ISLANDS - Hudson (for Harlow)

Fijian Crested Iguana Update. Peter Harlow (Taronga Zoo).

Research continues on the Fijian Crested Iguana Sanctuary Island of Yadua Taba. Suzie Morrison has just completed her first year's research on Yadua Taba where she captured and PIT tagged 270 resident iguanas in a quarter hectare dry forest quadrat containing 591 trees. This forest site will be the basis for her long term mark-recapture project to collect data on growth rates, movement, reproduction, survivorship, diet, and social structure. This year Suzie recorded the first ever data on the nesting habits of this species in the field. Several other projects are running simultaneously, including work on the phenology of important food tree species and the effect of the introduced exotic 'crazy ant' and Pacific rats (*Rattus exulans*) on iguana nest and hatchling survivorship.

Clare Morrison (University of the South Pacific) and her team of post-graduate biology students and Fiji National Trust staff recently completed the last of four field trips to investigate seasonal changes in crested iguana diet on Yadua Taba. Iguana tree-use data from six permanent 250 metre transects, as well as analyses of fecal material have given a good indication of diet. Tree-use data were collected on 1425 iguana sightings and 26 plant species were identified in the scats of 233 iguanas. The invasive plant and weed management plan for Yadua Taba continues to be carried out by the Iguana Sanctuary ranger Pita Biciloa (National Trust for Fiji Islands) and men from the nearby village on Yadua Island.

On the 40 ha island of Macuata where crested iguanas were re-discovered in 2004, Craig Morley (University of the South Pacific) and students, with local assistance, recently completed the last rapid iguana survey. Over 40 crested iguanas have been PIT tagged and both *Rattus exulans* and *R. rattus* have been identified, making this the first crested iguana population known to co-exist with *R. rattus*.



St Lucia Iguana 2006 Project Update. Matthew Morton (Durrell Wildlife Conservation Trust).

As in previous years, this work was a collaboration between Durrell Wildlife Conservation Trust and the St Lucia Ministry of Agriculture's Forestry Department, with assistance from volunteer overseas biologists.

Iguana Nesting - Nests were monitored for 44 days at Louvet (36 days between 1 February - 30 April) and 38 days at Grand Anse (34 days between 1 February - 30 April). As in 2004 and 2005, there was more nesting activity at Louvet than at Grand Anse. The mean tail-drag count for both beaches was lower in 2006 than in either 2004 or 2005. It is not possible to infer any population trends from just three years of data. This index, as planned, will have to be measured over a number of years, however there is the suggestion of a decline. This data has yet to be analysed (using Generalized Linear Modelling as in 2005), but linear regression suggests no significant trend, at least yet.

Average clutch size was 23 eggs/female (14-28, SD \pm 4.4, n = 14), including and additional five clutches from 2004. All eight nests opened in 2006 were reopened post-hatching and an average of 63% of eggs were confirmed hatched. 15% seemed infertile (no skeletal remains in egg), 7% fertile but unhatched (skeletal remains) and 15% were missing when nests were reopened.

Increasing Tourism Pressure - In early 2006, Louvet Estate was sold to FM Properties. At initial meetings with the new owners, they made clear their intentions for development, projected to include a hotel, golf course, and condominiums. We were able to present the new owners with preliminary suggestions for zoning the site to take wildlife sensitivities into account. These areas are primarily littoral vegetation behind the beach, in amongst which iguanas use sandy patches to nest, and 'ravine' areas (buffers around stream courses) which appear to have higher densities of iguanas (and other species of interest such as the white-breasted thrasher), and hopefully can be used by iguanas as migration corridors onto and away from the nesting area. Management of additional areas (such as the open beach at night during turtle nesting) would also be needed.

FM properties seemed positive about these suggestions and showed us a conceptual plan which avoided development in the sensitive zones (including relocating the hotel behind the beach, with footpaths for tourists through the littoral vegetation belt maintained as a nature reserve). However, no planning application that we know of has been submitted yet. The Forestry Department is expected to be consulted on Terms of Reference for any Environmental Impact Assessment and Durrell will be able to contribute to these Terms of Reference and hopefully, as with the Praslin Bay development, review the EIA with other referral agencies.

Non-native Predators - There was an increase in (known) kills of adult iguanas by dogs at Louvet this year, with six nesting females (that we know of) killed, most if not all over a period of two to three days. No evidence of cats was found at or near the nesting sites this year, although one was caught about a kilometer from the beach and euthanized. Our main effort on invasive predator control this year targeted the introduced small Indian mongoose.

Mongoose control research comprised the bulk of fieldwork in 2006, using a 72 hectare trapping grid of 90 live traps at Louvet. We attempted to test the hypothesis that a small effort in mongoose control could keep an area at a reduced population of mongooses for an extended period. Unfortunately, this test of mongoose response to an area cleared of mongooses was compromised by captures in the culling grid being much lower than predicted (10 individuals compared with >80 in 2005, albeit the latter over a slightly bigger trapping area). This is positive insofar as it suggests that mongoose culling has an even longer-lasting effect than we had anticipated, but it does mean it will be difficult to use the 2006 data to test the hypothesis as planned.

The large data set from this work has yet to be analysed but we believe that we will have a robust population density estimate. A preliminary estimate of pre-culling captures estimated the population at 69 mongooses (54-124 mongooses, 95% confidence limits; Huggins closed captures model, implemented in program MARK), or a density of roughly 0.6 mongooses per hectare. For the culling traps only the estimate was 21 mongooses (19-34, 95% CL) or 0.5/ha, compared with the 2005 estimate of mongoose density on the culling grid of 0.8/ha. It appears that relatively low-level culling has an ongoing effect (reduction in mongoose activity) even

Preliminary Diet Analyses for *Cyclura cychlura inornata* and *Cyclura cychlura figginsi*: Assessing Potential Impacts of Tourist Feeding. Kirsten Hines (The Institute for Regional Conservation).

Tourism is a staple of the Bahamian economy and over half the workforce is employed in tourism related industries. In an attempt to compete in this market, tour operators have turned to eco-tourism. Airline magazines now tantalize visitors with flashy ads that promise remote beaches in the Exumas and a chance to feed sharks, stingrays, and iguanas. Leaf Cay (Allen Cays), home to the largest population of endangered Allen Cays iguana (*Cyclura cychlura inornata*) and the most popular iguana feeding location, receives an ever-growing number of tourists, easily exceeding 100 visitors on an average day. The industry has been so successful that the concept has spread to the southern Exumas, affecting populations of endangered Exuma Island iguanas (*Cyclura cychlura figginsi*). In order to assess potential impacts of tourist grape offerings on iguana diet, 92 *C.c. inornata* fecal samples were collected from seven cays in the northern Exumas and 131 *C.c. figginsi* fecal samples were collected from six cays in the southern and central Exumas over the past year. While samples at most locations consisted of native vegetation, preliminary analyses indicate a dietary shift on Leaf Cay (Allen Cays), primarily at the tourist feeding beach. About 30% of fecal samples from this beach contained high concentrations of grapes and sand (compared to <10% for other areas on Leaf Cay and 0% on other cays) and one sample contained only grapes and sand. This beach was also the only area with a high incidence of diarrhea that dried to a cement-like tube instead of the natural cigar-style wrap of leaves. Initial observations suggest that minimal or infrequent food supplementation may not affect iguana diet, but prolonged periods of regular feeding appear to alter diet composition. This dietary shift may be limited to individuals that frequent feeding beaches, but as eco-tourism expands globally, more individuals of these species and others may be affected. Prohibiting the expansion of this industry seems unrealistic and maybe even unnecessary, but we must understand its impacts to minimize potential damage. Future research will focus on quantifying differences among scat samples; establishing a pre-tourist expansion baseline by analyz-

ing samples collected across the Exumas by John Iverson in the 1980's, examining the health impacts of a dietary shift, and recording behavioral differences between areas with tourist feeding and those with none.



CYCHLURA and IGUANA - Knapp

Taxon Reports for *Cyclura cychlura* and Future Research Plans for *Iguana iguana* and *I. delicatissima*. Charles Knapp (Zoological Society of San Diego).

Andros Iguana (*Cyclura cychlura cychlura*) - Some aspects of the Conservation and Management Plan for the Andros iguana that were identified as priority projects in November 2005 have been initiated or completed. Lee Pagni, Deirdre Ballou, and I (San Diego Zoo) received a \$10,000 USFWS Wildlife Without Borders grant for conservation education initiatives for Andros Island that focuses on raising awareness for the iguana. The grant includes provisions for teacher workshops, mobile outreach education kits, and funding for Ricardo Johnson's soccer club.

In June 2006, the Nature Conservancy organized a rapid ecological assessment of the marine and terrestrial ecosystems on the west side of Andros Island. This assessment was conducted, in part, to fill information gaps on the distribution of high-profile endangered species such as flamingos, sea turtles, and iguanas. Objectives for the iguana rapid assessment were to: 1) locate areas of relatively high iguana density; 2) survey within the existing Central Andros National Park boundary on North Andros; and 3) conduct general herpetofauna surveys to produce species distribution lists. In general, few, if any iguanas inhabit the west side of North Andros Island. Additionally, the existing National Park on North Andros Island is not adequate to ensure the long-term survival of the Andros Iguana.

Exuma Islands Iguana (*Cyclura cychlura figginsi*) - Surveys in the Exuma Island chain were conducted in April 2006. Objectives for 2006 were to: 1) survey iguana populations in the south-central Exuma chain; 2) translocate iguanas from Leaf Cay [northeast of Normans Pond] to Pasture Cay in the Exuma Cays Land and Sea Park to augment the initial colony that was translocated in 2002; and 3) collect preliminary

diet and body condition data for comparative studies of iguana populations inhabiting Exuma cays visited by tourists versus un-visited cays. In addition to the April surveys, Gaulin, Bitter Guana, and Pasture Cays were visited between 26 May and 4 June 2006.

During the April surveys, we captured and processed a total of 123 iguanas from five cays. During the May/June surveys, we captured an additional two founder iguanas from Pasture Cay, one iguana from Bitter Guana, and 51 iguanas from Gaulin Cay. Of the 51 Gaulin captures, 27 were recaptures dating back to as far as 1998. On 10 April, we set Sherman live rat traps on White Bay (n = 28 traps) and Leaf Cays (n = 30 traps). We trapped six rats from White Bay and none from Leaf Cay. To date, rats have been confirmed from White Bay, Gaulin, Bitter Guana, and Pasture Cays. North Adderly, Noddy, and Guana Cay still need to be surveyed for rats.

The translocated seven (5.2) founder iguanas recaptured on Pasture Cay all appeared healthy and gained body mass since last capture. Two founder iguanas (1.1) were observed but not captured. Three subadults that were hatched on the island were either captured or observed. Evidence of exploratory dig activity was observed on the north beach and two iguanas appeared to have nested.

Green Iguana (*Iguana iguana*) - A 2007 study will be conducted to test the locomotor effects of transmitter



Male *Cyclura c. cychlura*, Tiamo Resort, Andros. Photo by Joe Wasilewski.

burdening on hatchling green iguanas (*Iguana iguana*) in the laboratory and then correlate performance with survival of hatchlings in the field. Specific objectives will include: 1) measuring maximal sprint speed of *I. iguana* hatchlings affixed with radio transmitters that equal 2.5, 5.0, and 7.5% of their body mass; 2) measuring jump speed of hatchlings affixed with radio transmitters varying in the same ratios; and 3) releasing and radiotracking a subset of 30-40 hatchlings in the Gandoca-Manzanillo Wildlife Refuge on the Caribbean coast of Costa Rica to test for survival differences between the three different treatment groups.

Specific conservation goals for this study include quantifying the effects (if any) of transmitter burdening on lizards. Because radio transmitter studies will be required to answer conservation-oriented questions on multiple lizard taxa including the genus *Cyclura*, it is imperative that we have information pertaining to the effects of transmitter burdening in order to establish quantitative guidelines and recommendations for future ecological studies. In addition, green iguana populations are becoming threatened in parts of its range, therefore, survival and dispersal data stemming from this work will be used to guide future management strategies for the species.

Lesser Antillean Iguana (*Iguana delicatissima*) - A 2007 study will be initiated to investigate coastal populations of *I. delicatissima*. Specifically, we will investigate life-history variation between disturbed and undisturbed iguana populations. Study variables will include clutch size, age to reproduction, nest-site selection, hatch rate, juvenile and adult survival, and diet. Because coastal features on many of the Lesser Antillean islands are similar, data from "control" undisturbed and disturbed sites will be used to predict the fate of populations on Dominica, and other islands where coastal development is increasing due to tourism. In addition to investigating life histories, we will radiotrack hatchlings from nests to record dispersal and survival, and document significant predators between the two sites.



MARTINIQUE - Knapp (for Maillard)

The Conservation of *Iguana delicatissima* in Martinique and a Future Action Plan for the French West Indies. Jean-Francois Maillard (Agency of Hunting and Wildlife, Martinique) and Michel Breuil (Natural History Museum, Paris).

Iguana delicatissima has been protected in the French West Indian islands of Martinique and Guadeloupe since 1989. The French Ministry of Ecology and Sustainable Development, with the Strategy for Biodiversity, is responsible for preserving the endemic fauna and flora of the French tropical areas. Since early 2006 on Martinique, a new project was initiated to conserve and enhance the populations of *I. delicatissima*. The French Agency of Hunting and Wildlife (Office National de la Chasse et de la Faune Sauvage, ONCFS) in collaboration with Dr. Michel Breuil from the French Natural History Museum of Paris (Musée National d'Histoire Naturelle, MNHN) are the facilitators of this two-year project. This scientific and technical project has the financial support from the European Union, the French Ministry of Ecology, and the ONCFS.

In Martinique, the populations of iguanas are scarce. At least two populations are known to inhabit the north portion of the island, but there is a paucity of demographic information available because the mountainous areas are difficult to access. A second population inhabits Islet Chancel, a 70 ha island in the bay of Robert (Atlantic coast). The objectives of the ONCFS project are to assess the demographic and dynamic parameters of *I. delicatissima* on Islet Chancel, to augment the iguana population by introducing iguanas to Islet Ramier in the bay of Fort de France, and to remove individuals of *I. iguana*, which were released from a zoo and are experiencing rapid population growth.

From April to July, 168 adult iguanas have been captured, measured, PIT-tagged, and released on Islet Chancel. Using capture/recapture methods, we assess the population to be 600 individuals with a sex ratio of 1:1.3. We are waiting to publish our results because we need to complete our database and we want to compare spatial distribution of the two sexes between the breeding and non-breeding season. Additionally, M. Breuil has captured and marked adult iguanas since 1993 and we will be analyzing individual growth rates.

On Chancel, the physical parameter limiting the growth of the population appears to be poor conditions for nest burrow excavation. This limiting abiotic condition was first recognized in 1994 by the French Agency for the Forests (ONF). In 2006, we improved the nesting area on top of the islet by removing rocks, which were impeding burrow construction. The results were immediate as many females came to the site and burrow excavation was observed. Other nest sites will be improved by the end of the year.

With the help of the French Navy, and with permission of the owner of Islet Ramier (2 ha), a new population of *I. delicatissima* was introduced on the islet in July 2006. Nine adults from Islet Chancel were PIT-tagged and affixed with radio transmitters. After four months, the iguanas appear to have established normal home ranges and movement patterns.

The green iguana, *I. iguana*, population has been growing at an alarming rate on Martinique and the objective of the Ministry of Ecology in Martinique is to reduce and eliminate this species to avoid contact between the two species of iguanas. Negative effects of these contacts have been well documented in Guadeloupe. A new law on Martinique now allows *I. iguana* to be killed by the French Agency of Hunting and Wildlife police.

This project in Martinique could be used as a conservation template for other French West Indies islands. The IUCN-ISG is an important entity to help promote this project, as we the principle investigators of this project, must constantly reaffirm the commitment from the French authorities of the Ministry of Ecology in Martinique and Guadeloupe.

