

The mission of the IUCN SSC Iguana Specialist Group is to prioritize and facilitate conservation, science, and awareness programs that help ensure the survival of wild iguanas and their habitats.



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ISG Updates

A Message from the Co-chairs and Program Officer

After a protracted hiatus, the International Union for Conservation of Nature Species Survival Commission Iguana Specialist Group (IUCN SSC ISG) Newsletter has been resurrected in an effort to provide annual “hard copy” documentation of our group’s activities, project updates, and to further promote communication within the group and externally. We have seen significant changes since the last newsletter was published in 2008. Stesha Pasachnik (San Diego Zoo Global) and Chuck Knapp (Shedd Aquarium) have assumed co-chair responsibilities for the ISG, while Tandora Grant has received institutional support from San Diego Zoo Global to serve as program officer. A new steering committee was also formed and consists of members Allison Alberts, Daniel Ariano-Sánchez, Glenn Gerber, Peter Harlow, Rick Hudson, John B. Iverson, and Catherine L. Stephen (<http://www.iucn-isg.org/about/isg-committees>). We are indebted to our previous co-chairs, Glenn Gerber (San Diego Zoo Global) and Miguel Garcia (Puerto Rico Department of Natural Resources and Environment) for their dedicated service and efforts to advance and improve the ISG. Thank you!

The ISG has expanded in recent years and now includes 85 members from 24 countries, plus Puerto Rico for the 2013–2016 term. We are particularly excited about the increased membership from people working in range countries where iguana species occur. The efficacy of the group is more potent with in-country stakeholder commitment and advocacy. We hope that the newsletter facilitates partnerships and idea sharing from those who are unable to attend the annual meetings. The newsletter will also serve as an archive of activities and a reference for citing data and anecdotes.

In order to maximize the effectiveness of the newsletter, we need membership participation. We rely on you to draft taxonomic updates and submit reports. Updates, reports, and current events will be posted initially on the website. At the end of the year, all information received will be compiled into one volume and published by the ISG during the first quarter of the following year. Because of our hiatus, we included historic, non-published information from 2011–2013 in this current volume (12–13) and will resume volume 14 (to cover year 2014) in the first quarter of 2015.

Please let us know if you have any comments or suggestions. We look forward to serving you and increasing the usefulness of the ISG.

All our best,

Chuck, Stesha, and Tandora

ISG Membership Definition

Among the first duties for the new officers and Steering Committee was to create a “definition” of the group and its members. The following statement expresses what Iguana Specialist Group members are, how and why they are chosen, and what is expected of them during their term. As a volunteer network, the group succeeds by active participation from all of its members who contribute to our overall goal in a variety of ways. A full list of the membership can be found on our website (<http://www.iucn-isg.org/about/isg-members>).

The Iguana Specialist Group is comprised of volunteer experts with an interest in conservation of the world’s iguana species. We serve as the collective authority on iguanas and their status in the wild. Invitation is by suggestion of a current member, confirmation by another, and approval from the Steering Committee. Removal from the group is determined by a majority decision of the Steering Committee or request of the member. We seek to include representatives throughout the range countries of iguanas, as well as individuals with conservation and/or research expertise with each taxon.

ISG members encompass a diverse group of skills – scientific, education and outreach, conservation management, husbandry, fundraising, information technology, and policy. Members represent universities, zoological organizations, the private sector, NGOs, and government agencies. Members must play an active role in

conservation, research, education, or act as a valuable resource for information on iguanas, contributing to the overall visibility of the ISG during their 4-year term. Examples of member involvement include: active participation at annual meetings, contribution to Red List assessments, group organization and administration, in-kind contributions to programs (artwork, translation services, photography, desktop publishing), participation in conservation research efforts, and publication of research and conservation activities in scientific, government, and public outlets.

Reformatted ISG Website

In mid-2013, version 3 of the ISG website was launched with a completely redesigned look, and added new features and content. Tandora Grant (ISG, San Diego Zoo) created the site with the (nearly volunteer) expertise of a web developer and designer friend Taylor Tay. Special thanks go to George Waters for his help with the previous site built by Capstone, John Binns for inspiration from the original version 1, and John Iverson for editorial help and framework ideas.



The new site is built on an easily editable platform so that information can be updated frequently with member contributions. The site contains archives of our meetings and publications, as well as recent taxon reports from the field, volunteer opportunity postings, and taxonomic information on iguana species. A template has

All references have complete citation information and an abstract when available. Species names were also added to every reference to direct the search engine when the title is vague or has no abstract. The species keyword does not firmly indicate the subject of the article however, but is intended to draw a searcher's attention to some bit of data or information included on a species in the article. This is particularly true for historic scientific names, summary papers, or iguana-generic articles. For example, keywords are included for species that were used as outgroups in genetic analysis papers, rather than only the group under study. Embedded keywords from more recent literature are not included because this would only be relevant for a small fraction of the Library. Search words are matched to any text in the citation: title, author, book name, abstract, year, etc.

All visitors to the Library have access to search functions and the ability to export search results as text files, pdfs, rtf's, etc. If the article was published in a newspaper, open-access journal, or before 1923, a pdf copy is downloadable for everyone (if the Library has a copy!). ISG members have a specific login that allows access to download all the available pdfs in the Library. This eliminates the step of members individually asking Tandora to share a copy of articles, but still conforms to copyright laws by keeping the login within a private group. Members are asked that they do NOT share their login information freely with others, as this violates copyright laws. Temporary logins for someone, such as a student, can be created by emailing a request to Tandora. Otherwise, anyone can send an exported list of the references for which they would like copies to Tandora, and pdfs will be returned.

The Iguana Taxonomic Working Group

In 2011, the ISG created a special advisory group to address taxonomic issues in iguanas - The Iguana Taxonomic Working Group (ITWG) - a necessary prerequisite for revision of our IUCN Red List of Threatened Species assessments. John B. Iverson leads this group, which is comprised of six additional people: Larry J. Buckley, Kevin de Queiroz, Richard E. Etheridge, Bradford D. Hollingsworth, Stesha A. Pasachnik, and Catherine L. Stephen. Tandora Grant serves with the group as consistency editor. The group members were invited to serve on this committee based on their expertise in iguana systematics. The first objective of the group was to compile a working checklist for iguanas with the most up-to-date taxonomy (available at: <http://www.iucn-isg.org/publications/general-publications>). As additional research on the systematics and taxonomy of iguanas is published, the ITWG periodically updates the checklist. The next edition is expected to be published as part of an iguana monograph special volume in *Herpetological Conservation and Biology*. The group does not intend to make new taxonomic decisions; however, if there is a discrepancy in the literature, the group will debate the data and reach a taxonomic conclusion based on majority rule. The checklist is thus meant to be the authoritative reference on iguana taxonomy.

A large group of approximately 50 people, mostly young adults, are posed for a group photo outdoors. They are arranged in several rows, with some individuals sitting on the ground in the front. Many of the people are wearing blue t-shirts that feature a cartoon character, likely a mascot. The background shows a building with palm trees and a clear sky. The overall atmosphere is casual and festive.

Environmental Threat in Jamaica

Jamaica's largest protected area, the Portland Bight Protected Area, is under threat of intense development. This area is globally recognized as one of the last and greatest remaining examples of tropical dry forest in the Caribbean; a habitat that is among the world's most threatened ecosystems.

Illegal Burning of Hellshire Hills Forest. Early in 2013, considerable press raised awareness of the on-going illegal burning of the Hellshire Hills forest for the production of charcoal. The Hellshire Hills is home to the tiny remnant population of the Critically Endangered Jamaican Iguana (*Cyclura collei*), as well as numerous endemic dry tropical forest plants and animals. At the request of the ISG, the IUCN Director General and the Chair of the IUCN SSC sent an advocacy letter regarding this issue addressed to Robert Pickersgill, Jamaica's Minister of Water, Land, Environment, and Climate Change. For more on this letter, see the "IUCN Letters of Concern" section below. ISG Member Heidi Davis organized an online petition that was also sent to the Jamaican minister. In addition, ISG Member Byron Wilson and Co-Chairs Chuck Knapp and Stesha Pasachnik wrote a guest column for and letters to the editors of two Jamaican newspapers expressing concern about this dire situation and encouraging discussion between forest managers and policy makers. Click on the articles' titles to view them online:

["Charcoal Exportation a Threat to Our Forests"](#)

["Charcoal Export Will Affect Jamaicans, Forests, and Wildlife"](#)

["Don't Chop Us Dry"](#)

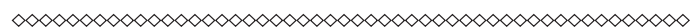
Transshipment Port on Goat Islands. Now, large-scale development is threatening the Portland Bight Protected Area (PBPA). In Beijing, on 22 August 2013, Jamaica's environment minister, Robert Pickersgill, announced the Goat Islands is "under very serious consideration" as the site to build a massive transshipment port proposed by state-owned China Harbour Engineering Company. Although full details have not been disclosed to the public, the proposal would involve leveling the Goat Islands, dredging in the bight,

and will include a causeway and infrastructure development on the mainland as well, opening up the Hellshire Hills to human impacts on the western side, close to the core forest where the iguana persists.

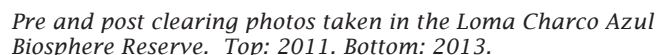
The two Goat Islands have long been recognized as extremely important for long-term conservation of the Jamaican Iguana and other endemic species, notably the Jamaican Boa and Jamaican Coney. As highlighted in IUCN's recent book *Priceless or Worthless? The World's Most Threatened Species*, our successes with captive headstarting and field conservation for the Jamaican Iguana has kept the animal from going extinct, but it will not be enough unless the government becomes proactive in habitat protection. In particular, efforts should continue toward eradication of invasive alien species (mongoose and rats) on the Goat Islands, reintroduction of iguanas and other vertebrates, and protection of the islands for the future of all Jamaicans. This work was started in accordance with action steps outlined in the IUCN-sponsored Jamaican Iguana Species Recovery Plan 2006.

A shipping port in this region will also have serious negative effects on the marine environment and will threaten the fish sanctuaries that fisherman from Kingston and environs depend on. Two-thirds of Jamaica's mangroves are found in the PBPA and together with the coral reefs provide shoreline protection from storm surges, flooding and beach erosion, as well as carbon sequestration benefits valued in the millions.

In response to this crisis, again ISG members wrote editorials for the Jamaican newspapers and international press, as well as conducted interviews. Several articles were published in conjunction with the annual ISG meeting held in Kingston. Working closely with the local environmental advocacy group, Jamaica Environment Trust, Tandora Grant created a website as a repository for information on this issue, which includes an up-to-date compilation of all press releases, documents, and stunning photographs of the region at stake. Please visit <http://savegoatlands.org>.



Land Clearing in the Loma Charco Azul Biosphere Reserve. Government-sponsored agricultural projects have been created to reduce poverty in many rural areas of the Dominican Republic. In early 2013 the Institute for Agrarian Developmental (IAD) instated one such project, calling for vast land clearing and irrigation within a protected area, the Loma Charco Azul Biosphere Reserve. Further the Minister of the Environment himself signed off on the plan. This is a complicated situation as the IAD are attempting to provide agricultural land for those who have been displaced due to flooding.



At least five species known to occur within this reserve are listed on the IUCN Red List, including the Critically Endangered Ricord's Rock Iguana (*Cyclura ricordii*), the Vulnerable Rhinoceros Rock Iguana (*Cyclura cornuta*), the Endangered Lignum Vitae tree (*Guaiaecum*

officinale), and the unassessed but rare Hispaniolan Brown Racer snake (*Haitiophis anomalus*). This area is also the only known locality for a soon-to-be-described large *Anolis* species. In addition to its United Nations Educational, Scientific and Cultural Organization (UNESCO) designation, Loma Charco Azul is also an Important Bird Area (IBA), as well as a Key Biodiversity Area (KBA) as defined by Conservation International. Given the high biodiversity value of the area, a local NGO exposed this issue through conventional and social media, followed by a letter of concern from the IUCN Director General and the Chair of the IUCN SSC, as requested by the ISG (see next section for more on this advocacy letter). These actions generated a lot of public outcry and are believed to have prompted the IAD director to reconsider their actions. The ISG is working with Grupo Jaragua to try to stop this destruction. However, clearing is continuing in this general area, and international pressure needs to remain constant.

Letters of Concern from the IUCN

The mission of the IUCN is to provide a neutral forum for governments, NGOs, scientists, business, and local communities to find practical solutions to conservation and development challenges. The role of the specialist groups within the Species Survival Commission (SSC) is to provide the best source of science-based, independent, and technical expertise on species to the IUCN. Because most of the world's iguanas are highly threatened by human activities, their conservation often involves the need for advocacy measures. While ISG members are usually at the forefront of these issues, we must balance our involvement without being perceived as advocates and risk our credibility as science advisors. However, we can take advantage of IUCN's inter-governmental status to gain political access otherwise unavailable to the general public and address our concerns. Most of the countries in which iguanas live are among the IUCN's 200+ government members.

In 2013, the ISG Co-Chairs and Program Officer worked with the SSC to write letters in response to environmental threats in Jamaica and the Dominican Republic (see above). The letters were signed by the IUCN Director General, Julia Marton-Lefèvre, and the SSC Chair, Simon Stuart, and sent directly to the respective government ministers, as well as the IUCN regional offices.

In Support of a Ban on the Export of Charcoal, Jamaica - 28 May 2013

In Protest of Development in the La Reserva Biológica Loma Charco Azul, Dominican Republic - 21 August 2013



The three iguana species affected by the environmental threats in Jamaica (left) and the Dominican Republic (middle and bottom) for which letters of concern were written by the IUCN SSC in 2013.

Left: The Jamaican Iguana (*Cyclura collei*). Photo by Joe Burgess.

Middle: The Ricord's Rock Iguana (*Cyclura ricordii*). Photo by John Binns.

Bottom: The Rhinoceros Rock Iguana (*Cyclura cornuta*). Photo by Robert Powell.



2011 Taxon Reports

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Andros Iguana (*Cyclura cyclura cyclura*)

Research Update 1 to 6 May 2011. A team of researchers from the Shedd Aquarium in Chicago, "citizen scientists," and staff from the Bahamas National Trust (BNT) visited Andros Island from 1 to 6 May 2011 to continue a 12-year study of the Andros Iguana, *Cyclura cyclura cyclura*. The BNT participants included Mr. Tavares Thompson, Andros park warden, and Mr. Cordero Bullard the New Providence park warden. Shedd Aquarium's research vessel, *Coral Reef II*, was used as a logistical platform for the expedition.

The objectives of the 2011 expedition were to 1) continue a long-term mark-recapture study, 2) evaluate the use of a remote hunting camp and survey for disturbance, 3) collect blood samples from northern island localities in order to increase the intra-island range of sampled sites, and 4) perform ocular examinations on iguanas.

Mark-recapture study. We set a new record for the six-day citizen scientist research expeditions by capturing and releasing 52 iguanas (20 males, 32 females). We drew blood from another animal that was partly hidden in a hole but that could not be removed safely. Iguanas were captured from seven locations, including four new localities without previous capture histories (Figure 1). Captured iguanas ranged in snout-vent length from 11.1 to 51.0 cm (mean = 35.0 cm) and in body mass from 65 to 5940 g (mean = 2476 g).

To date we have captured and processed 457 iguanas, including 131 recaptures. Most of the recaptures are derived from two locations: Dissertation Point at Mangrove Cay (1999) and Sandy Cay (2002). Both sites served as the primary study locations during C. Knapp's 2002-2004 detailed doctoral study of the species. We have captured 118 iguanas, including 49 recaptures at Mangrove Cay (Dissertation Point), and 141 iguanas including 60 recaptures at Sandy Cay (Table 1). In 2011, we recorded both ticks and chiggers as ectoparasites. We recorded from zero to 200 ticks on individual iguanas (mean = 26.1; SD = 36.2). We collected a subsample of ticks from captured iguanas and sent them to the Institute of Arthropodology and Parasitology at Georgia Southern University for identification. The chiggers (family Trombiculidae) were sent to the Museum of Biological Diversity at The Ohio State University and are awaiting identification.



Figure 1. Iguanas were captured at seven sites between North and South Andros in May 2011. The four sites north of Middle Bight (Black Creek Cay, Little Wood Cay, Beach Cay, and Booya Cay) had not previously been visited. We collected 4, 1, 2, and 4 blood samples from each cay, respectively.

Table 1. Recapture information by year for two long-term study sites on Andros Island.

Year	Captures	Recaptures	% recaptures	Cumulative # marked	Cumulative # recaptured
Sandy Cay					
2002	14	0	0	14	0
2003	27	3	11	38	3
2004	33	17	52	54	20
2005	25	12	48	67	32
2007	13	10	77	70	42
2009	13	9	69	74	51
2011	16	9	56	81	60
Dissertation Point					
1999	15	0	0	15	0
2000	9	2	22	22	2
2001	7	2	29	27	4
2002	13	5	38	35	9
2003	12	5	42	42	14
2004	14	7	50	49	21
2005	8	6	75	51	27
2007	12	8	67	55	35
2009	11	6	55	60	41
2011	17	8	47	69	49

Evaluate a remote hunting camp and survey for disturbance. As we do every opportunity while on island, we visited a hunting camp on the west side of Alcorine Cay. This camp was first visited by a joint Shedd/BNT team in 1998 and two iguanas were found with their arms and legs trussed behind their backs. Since then, there has been evidence of further iguana hunting. In the past, the camp has shown signs of varying degrees of use. This year, the camp appeared to have been used within the previous 1-2 months and iguana bones were discovered onsite, though they did not appear recent (Figure 2). While no evidence of invasive species was found south of Middle Bight, we did encounter hog trails and scat during our only site visit on North Andros, located northeast of Black Creek Cay.

Figure 2. Right: Iguana bones discovered at hunting camp.



Left: Evidence of hunting camp on Alcorine Cay.

Blood samples. Andros Island is a composite of three main islands and dozens of associated cays, which may influence genetic structuring of the collective iguana population. Shedd is partnering with Dr. Mark Welch's laboratory at Mississippi State University to perform an intra-island population genetic study using blood samples collected previously and during this expedition. Our focus this year was to expand our study sites by including cays where iguanas previously had been too difficult to find. The increased sample locations will help elucidate the pattern of iguana movements between islands and whether Andros has any isolated iguana populations that have unique genetic signatures. During this trip, we collected 53 blood samples, including populations from four new locations north of Middle Bight (Figure 1). We now have genetic samples from 17 isolated iguana populations extending over 140 km.

Ocular examinations. We performed ocular health assessments and collected baseline data for tear production and intraocular pressure in this species. Both parameters can change significantly with disease and knowledge of baseline values in a wild population is vital for the correct diagnosis and treatment of disease in managed and wild iguanas. Measurements of tear production have not been published for any reptile species and measurements of intraocular pressure have only been measured in select tortoise species, despite these tests being a standard of care for mammalian patients.

A Shedd Aquarium veterinary resident, Dr. Kimberlee Wojick, performed complete ophthalmic examinations using an ophthalmoscope on all captured iguanas. She measured tear production using a phenol red impregnated cotton thread placed in the conjunctival fornix of each eye and held in place for 15 seconds (Figure 3). Intraocular pressures were measured in both

Allen Cays Iguana (*Cyclura cychlura inornata*)

Research Update 15 to 25 May 2011. This was the 32nd year of our studies of the Allen Cays Iguana in The Bahamas. With a full team of undergraduates from Earlham College and Denison University, we captured 240 iguanas (86% recaptures) on Leaf Cay (Figure 1), 77 on U Cay (86% recaptures), and seven on Allen Cay (five recaptures). We have now accumulated over 6800 iguana captures in the Allen Cays over our 32-year study! See Table 1.



Figure 3. Tear production measured by phenol red impregnated cotton thread placed in the conjunctival fornix.



Figure 4. Intraocular pressures measured using the TonoVet® rebound tonometer.



Charles Knapp
Conservation and Research Dept.
John G. Shedd Aquarium
USA



Figure 1. Top: John Iverson (Earlham) and students plan capture strategies in the bush on Leaf Cay.

Bottom: Dr. Geoff Smith of Denison University and student extricate Leaf Cay Iguana from capture net.

Photos by Lynne Pieper.

Table 1. Recapture information per year for Allen Cays Iguanas. Abbreviations are: caps (captures), recaps (recaptures), and Cum (cumulative). Total number of captures for U Cay is 2255 (550 + 1705) lizards and for Leaf Cay it is 4418 (1220 + 3198). All trips for 1980 through 2000 were in mid-March. Trips in 2001 were in mid-May and for 2002 in mid-June to mid-July. Censuses in 2003–2011 were also in mid-May.

Year	U Cay					Leaf Cay				
	Total caps	Total recaps	% recaps	Cum. # w/ marks	Cum. # recaps	Total caps	Total recaps	% recaps	Cum. # w/ marks	Cum. # recaps
1980	30	0	0	30	0	14	0	0	14	0
1982	43	9	21	64	9	50	3	6	61	3
1983	48	25	52	87	34	51	26	51	86	29
1986	75	37	49	125	71	79	19	24	146	48
1988	111	58	52	178	129	109	59	54	196	107
1990	113	83	74	208	212	136	81	60	251	188
1992	124	89	72	243	301	148	102	69	297	290
1993	34	33	97	244	334	94	73	78	316	363
1994	150	94	63	300	428	204	110	54	410	473
1995	123	106	86	317	534	150	125	83	435	598
1996	113	86	76	344	620	177	126	71	486	724
1998	95	79	83	360	699	205	150	73	541	874
2000	169	124	73	405	823	254	175	69	620	1049
2001 ^a	140	110	79	435	933	284	220	77	679	1274
2001 ^b	40	34	--	441	967	209	89	--	799	1363
2002 ^c	143	118	83	460	1085	350	266	76	880	1629
2002 ^d	37	34	--	463	1118	147	72	--	945	1701
2003 ^e	102	95	93	470	1213	214	204	95	955	1905
2004 ^f	124	112	90	482	1325	376	257	69	1074	2162
2005 ^g	108	96	89	492	1421	246	221	90	1093	2383
2008 ^h	114	94	82	512	1515	289	245	85	1137	2628
2009 ⁱ	81	69	85	524	1584	198	173	87	1162	2801
2010 ^j	71	55	77	540	1639	220	190	86	1192	2991
2011 ^k	77	66	86	550	1705	240	207	86	1220	3198

^a Excludes 1 additional capture on Allen Cay.
^b Excludes 6 additional captures (including 1 recapture) on Allen Cay.
^c Excludes 6 additional captures (including 3 recaptures) on Allen Cay.
^d Excludes 1 additional capture (a recapture) on Allen Cay.
^e Excludes 7 additional captures (including 4 recaptures) on Allen Cay.
^f Excludes 9 additional captures (including 7 recaptures) on Allen Cay.
^g Excludes 6 additional captures (including 5 recaptures) on Allen Cay; 3 new captures on the second small cay north of Leaf Cay.
^h Excludes 3 additional captures (including 1 recapture) on Allen Cay; also includes captures in March by Chuck Knapp.
ⁱ Excludes 4 additional captures (all recaptures) on Allen Cay; 1 new capture on the second small cay north of Leaf Cay.
^j Excludes 4 additional captures (2 recaptures) on Allen Cay; 1 new capture on the second small cay north of Leaf Cay.
^k Excludes 7 additional captures (5 recaptures; 1 skeleton) on Allen Cay.

The sex ratio of iguanas on Leaf Cay has stabilized at near 1:1 (102 males:101 females this year; 92:102 last year), however, the sex ratio on U Cay continues to be significantly skewed toward females (28 males:46 females this year; 20:49 last year). We believe that the latter bias is at least in part due to the disappearance of most of the large, relatively tame males that came to the beach to be fed in recent years. For example, of 17 large males (> 40 cm body length) captured alive in 2005, only nine were captured in 2006, eight in 2007, six in 2008, five in 2009, two in 2010, and only one in 2011. A decline from 17 to one in six years represents an annual survival rate of 62%, far below the long-term adult male survival rate of nearly 90%. Even if two (i.e., we missed one) were still alive in 2011, the annual rate would still be only 70%. Several of these males have been found dead on U Cay and one was found freshly dead on the rocks on Leaf Cay! We believe that the large aggressive iguanas are being killed or removed by humans (either for food, the pet trade, or to reduce physical risk to tourists feeding them) (Figure 2). Further evidence of this activity was the appearance on the main beach of Leaf Cay of female #90 this year, originally marked on U Cay as a juvenile in 1994 and captured in 11 different subsequent years on U Cay (including 2010). She is now 22.7 years old and must have been moved by humans.

Tail break frequencies remain quite low for these iguanas (Leaf Cay females, 5.0%; Leaf Cay males, 4.9%; U Cay females, 8.7%; U Cay males, 10.7%), although the higher proportions of broken tail iguanas on U Cay supports the idea that humans have recently been harassing and/or removing iguanas from the cay. Once again this year we found an iguana (ca. 25 cm body length) dead in the crotch of a tree on Leaf Cay where it must have accidentally slid after foraging arboreally. All toe clips from newly marked iguanas were preserved in alcohol and archived with Sandra Buckner in Nassau.

This year we implanted an additional 65 microchip (PIT) tags in iguanas, and have now PIT tagged a total of 879 lizards in the Allen Cays (Table 2). We had four PIT tag failures this year. However, the failure rate of PIT tags has been quite low over our 18 years of using them, as has been the failure rate of identifying toe clips due to natural toe loss. We will continue to PIT tag as many subadults and adults as possible each year as funds allow (\$9 per tag), because the redundancy of using both methods simultaneously insures the positive identification of every iguana so marked.



Figure 2. Top: Earlham undergraduates prepare to educate arriving boat of tourists on Leaf Cay about iguana conservation.

Bottom: Tourists feed grapes to iguanas on Leaf Cay beach. Using a stick helps to reduce the amount of undesired sand ingested by the iguana.

Photos by Lynne Pieper.

Finally, on 18 May 2008 we deployed a digital rainfall gauge in the interior of Leaf Cay (Table 3). Data on the logger was downloaded on 18 May 2009 and deployed again to record for the next year but it malfunctioned. The logger was re-deployed on 19 May 2010 and recorded properly until 19 March 2011 when the battery died. The unit was again deployed on 15 May 2011 to record data for the coming year. Total rainfall from 18 May 2008 to 18 May 2009 was 23.65 inches (60.07 cm) and from 19 May 2010 to 19 March 2011 it was 38.91 inches. The seasonal pattern was similar in both years, with a wet season from mid-June to December. However, 2010 was much wetter than 2008, primarily due to the abundant October rainfall associated with Hurricanes Otto and Paula in 2010.

Table 2. Tally of PIT (passive integrated transponder) tags deployed and their success rates for Allen Cays Iguanas. Abbreviations are: Recaps (recaptured lizards), Cum (cumulative), True tag failures (tags palpable under skin, but no signal), and Other tag failures (tags not palpable and no signal). Data for 2001-2011 are for May captures only.

Year	U Cay					Leaf Cay				
	Number newly tagged	Cum total tagged	Recaps with tags	True tag failures	Other tag failures	Number newly tagged	Cum total tagged	Recaps with tags	True tag failures	Other tag failures
1993	5	5	0	--	--	11	11	0	--	--
1994	13	18	3	0	0	3	14	5	0	0
1995	52	70	10	0	0	19	33	8	0	0
1996	56	126	36	0	0	56	89	19	0	1
1998	0	126	57	0	3	77	166	49	1	2
2000	29	155	74	0	1	55	221	80	0	2
2001	24	179	75	0	0	14	235	93	1	2
2002 ^a	6	185	65	0	0	20	255	65	2	0
2003 ^b	14	199	58	0	0	52	307	66	3	1
2004 ^c	15	214	65	0	0	51	358	106	1	0
2005 ^d	10	224	50	0	1	52	410	105	0	1
2008 ^e	32	256	27	0	0	74	484	100	0	2
2009 ^f	8	264	41	0	2	30	514	124	1	1
2010 ^g	15	279	45	0	0	21	535	129	0	2
2011 ^h	23	302	43	0	0	42	577	135	4	0

^a Excludes PIT tags placed in 3 iguanas on Allen Cay.

^b Excludes PIT tags placed in 5 iguanas on Allen Cay.

^c Excludes PIT tags placed in 3 iguanas on Allen Cay; also excludes 7 carcasses (2 on U; 5 on Leaf) still bearing tags.

^d Excludes PIT tag placed in 1 iguana on Allen Cay (total now with tags = 15); also excludes 1 of 6 carcasses (on Leaf Cay) still bearing tags.

^e Excludes PIT tags placed in 2 iguanas on Allen Cay (total now with tags = 17); also excludes 3 of 9 carcasses still bearing tags.

^f Excludes PIT tag placed in one iguana on Allen Cay (total now with tags = 18); also excludes 4 of 6 carcasses still bearing tags.

^g Excludes PIT tags placed in 2 iguanas on Allen Cay (total now with tags = 20); also excludes 2 of 5 carcasses still bearing a tag.

^h Excludes PIT tag placed in 1 iguana on Allen Cay (total now with tags = 21); also excludes 1 of 5 carcasses still bearing a tag.

Table 3. Monthly rainfall (inches) recorded in digital data logger on Leaf Cay in the Allen Cays from 18 May 2008 to 18 May 2009 and 19 May 2010 to 19 March 2011.

[illegible]

Allen Cay. We spent one full day on Allen Cay this year (18 May) and despite the thick vegetation, the razor-sharp honey-comb rocks, and the dangerously large (> 1 m) iguanas on the island, we succeeded in capturing seven of the giants there (four males, two females, and one skeleton). Five of the six live iguanas were recaptures from previous trips. We have captured a total of 24 different iguanas on Allen Cay over the past 11 years, but have found two of those dead and another four as unidentifiable skeletons. In addition, four of the iguanas that we have captured on Allen Cay were originally marked by us on Leaf Cay and were presumably transported there by unknown persons (not us). While on the island, we observed a copulation event between iguanas at ca. 2:00 PM and part of the group observed a small iguana (ca. 25 cm body length). This is the first time that we have ever observed a small iguana on the cay, which we have attributed to a lack of nesting habitat. Whether that small iguana was a natural waif, was introduced by humans, or was the result of a successful nesting event on Allen Cay is unknown. All six live iguanas were relocated to Flat Rock Reef Cay in anticipation of the impending mouse eradication on Allen Cay by Will Mackin and Island Conservation. We will return 20-27 August 2011 to locate and attempt to relocate all remaining iguanas from Allen Cay. If we assume that we have previously captured all 24 iguanas on the cay and that the six skeletons that we have found on the Cay were among those 24, it would suggest that 18 iguanas inhabited Allen Cay in May. Since we relocated six in May, our goal for August will be to capture the

remaining approximately twelve individuals. As in all years for the past decade, we also observed many carcasses of Audubon's Shearwaters, presumably due to Barn Owl predation.

Flat Rock Reef Cay. Iguanas were introduced by humans to this 5.3 hectare cay in about 1996 (see previous reports) and the population has grown rapidly to a current size of ca. 200 iguanas (Table 4). We spent only one day (20 May) on Flat Rock Reef Cay (FRRC) this year but captured 48 iguanas (71% recaptures). Through May 2011, we have marked a total of 141 iguanas on FRRC (76 with PIT tags) and tallied 165 recaptures. It is clear that the population is still growing and the island can likely support at least 400 iguanas.

Bush Hill Cay (Acklins Iguana). For the ninth year (2002-2010, except 2006) we visited Bush Hill Cay at the northern limit of the Exuma Cays Land and Sea Park to census the introduced population of Acklins Iguanas (*Cyclura rileyi nuchalis*) there. During two hours on 22 May and all day 23 May we captured and processed 57 iguanas (22 males, 32 females, 3 unsexed; 6 new, 51 recaptures). We have now marked a total of 324 iguanas on Bush Hill and recorded 461 total recaptures (Table 5).

We again captured a large rat (*Rattus norvegicus*?) on Bush Hill Cay and it is clear that the population is large. Furthermore, we believe that the extremely high frequency of iguanas with regenerated tails (and forked tails) on this cay is the result of attacks by rats. This year 59% of captured males, 63% of females, and 33% of

Table 4. Recapture information per year for iguanas on Flat Rock Reef Cay.

Sample Year (month)	Total captures	Total recaptures	Percent recaptures	Sex ratio (M/F)	Cumulative # w/ marks	Cumulative # recaptures
2001 (May)	2	0	0	2/0	2	0
2003 (May) ^a	3	0	0	1/2	5	0
2005 (May)	7	0	0	5/2	12	0
2006 (March)	38	5	13	19/13	45	5
2006 (July)	26	13	50	11/14	58	18
2007 (Jun-Jul)	19	14	74	11/8	63	32
2008 (May) ^b	37	19	51	16/14	81	51
2008 (July) ^c	55	38	69	23/27	98	89
2009 (May)	18	9	50	8/6	106	98
2009 (July)	22	14	64	13/9	114	112
2010 (May)	27	19	70	12/11	127	131
2011 (May)	48	34	71	21/25	141	165

^a Includes 1 individual originally marked on Leaf Cay.
^b Excludes 4 carcasses.
^c Excludes 1 carcass.

Table 5. Capture information per year for Acklins Iguanas introduced to Bush Hill Cay. All trips 2002–2005 were 24 hours or less in mid-May. The 2007 trip was 1.5 days in late June. The trips in 2008 and 2011 were 1.5 days in mid-May. Those in 2009 and 2010 were 48 hours in mid-May.

Year	Total captures	Total adults ^a	Total juveniles	Total recaptures	Percent recaptures	Cumulative # with marks	Cumulative number recaptures
2002	75	75	0	--		75	--
2003	72	69	3	16	22	131	16
2004 ^b	104	103	1	42	40	194	58
2005	106	105	1	59	56	241	117
2007 ^b	96	93	3	58	60	279	175
2008 ^b	79	73	6	65	82	293	240
2009 ^b	75	68	6	61	81	305	301
2010	116	109	7	103	89	318	404
2011	57	54	3	51	89	324	461

^a includes all individuals 20 cm SVL or larger (the size when the juvenile pattern begins to fade)
^b excludes single carcass found

juveniles had regenerated tails. We still have no evidence that Hutia (*Geocapromys* spp.) inhabit the island.

Future Plans. As mentioned above, we will return in August 2011 with the purpose of relocating the remaining iguanas from Allen Cay to Flat Rock Reef Cay so that mice eradication can proceed. However, the details of our work in 2012 are still uncertain. We may focus on the iguana nesting season on Leaf Cay in early July in order to investigate the existence of multiple paternity in the Allen Cays Iguana, but this will depend on availability of funding.

Acknowledgments. This work would not have been possible without the continued support from Mrs. Sandra Buckner, the Bahamas National Trust, The Bahamas Environment Science and Technology (BEST) Commission, the Exuma Cays Land and Sea Park, The Bahamas Department of Agriculture, Powerboat Adventures, 7 C's Charters, John Alford and Barbara Thompson (owners of Leaf Cay), and Greg Cottis (owner of U Cay). The financial support of Dr. Ned and Sally Test, the Cope Museum Fund of Earlham College, and 127 different Earlham College students (and six faculty) over the past 32 years is also greatly appreciated.



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Cuban Iguana (*Cyclura nubila nubila*)

Nesting report May and June 2011. This report describes a nesting site of *Cyclura nubila nubila* in the coastal area of Guanahacabibes National Park, in westernmost Pinar del Río Province, Cuba (Figure 1). According to Christian (1986), the Cuban Iguana is extremely secretive (less evident nests); as to its nesting and defense of its nest, it is very variable and less vigorous than the other species of *Cyclura*.

The observations took place at the close of May and in June 2011 and were conducted along the strip of coastal vegetation near the 14-kilometer road stretching from the coastal community at La Bajada to Maria la Gorda International Diving Center on the border of the conservation area of Corrientes Cape.

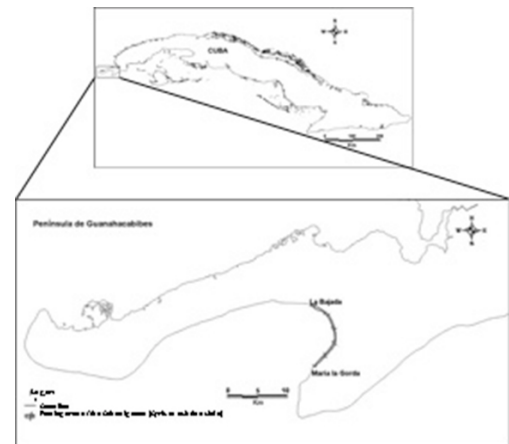


Figure 1. Location of the nesting area of the Cuban Iguana (*Cyclura nubila nubila*) in Guanahacabibes Peninsula, Pinar del Río.

The road was built on the coastal dune, where the vegetation complex of sandy coast predominates, dominated by *Coccoloba uvifera*, *Thrinax radiata*, and *Bursera simaruba*, among other species that are typical of this plant formation. The substratum where the nests were observed is made up fundamentally of sand, some earth, and remnants of dead corals accumulated as a result of sea floods and intensive surge generated by hurricanes that have swept the peninsula.

In May through June 2011, 20-32 female iguanas were counted in each survey (3 surveys per month) along the 14 kilometers of road. No male specimens were found. These numbers indicate that this is an egg-laying site, which is affirmed by the residents in the area. We think this is not the only egg-laying site in the Park, since there has been reference to other sites located in Playa Antonio and Playa La Barca, and the westernmost area of San Antonio Cape that are used by the iguana population living in the cliffs. It seems that this site is used by the population distributed in the forest areas next to the coastal sector from La Bajada to Maria la Gorda.

We found female iguanas digging their nests and going in and out of them to the left of the road, as we went from La Bajada to Maria la Gorda in a strip of land one to two meters wide and demarcated by the road and the plant formation typical of the dune. This strip is covered with low grassy vegetation due to periodic land clearing (Figure 2).

Many nests were found on the very edge of the road - the nest tunnels stretching under the pavement - while others were found a little farther into the inner strip (Figure 3).



Figure 2. Nesting site of *Cyclura nubila nubila* on the edge of the road in Guanahacabibes National Park.



Figure 3. *Cyclura nubila nubila* nest located very close to a road.

In May, 35 nests were quantitated along a one-kilometer transect, and in June, 17 nests were found along another one-kilometer transect in an adjacent area, but no nests were opened. We do not know whether each iguana makes one or several attempts to make its nests, as is common for *Cyclura cyklura* in The Bahamas (Iverson *et al.* 2004).

This is the second nesting site of this species that has been described for science in Cuba. The other description is from the sector of Monte Cabaniguán within Delta del Cauto Fauna Refuge, in the southeastern region of Las Tunas province, which also references the nesting sites of *Crocodylus acutus*.

As this nesting site is located in an area of public use within the National Park and is in proximity of the road leading to a tourist resort, protection of this area is representative of the traditional conflict between conservation and development. Therefore, immediate management measures will be taken to protect the site and mitigate the effects of human activities: warning signs will be erected during the breeding season, land clearing will be regulated along the edge of the road, and an environmental education program will be implemented and targeted mainly at the managerial personnel and tourist resort employees.

We propose for the short term to initiate studies of this nesting site in order to assess the following parameters: description of the substratum and vegetation, determination of nesting phenology, and quantify the density of nests, their sizes, and the percentage of hatching success, etc. (Figure 4).



Figure 4. Specialists of Guanahacabibes National Park while collecting data to describe the nests of *Cyclura nubila nubila* and the nesting site.

Description of this nesting site for *Cyclura nubila nubila* and its further detailed study will contribute to improved planning for the functional zoning of the protected area and will achieve better conciliation between the conservation and management of this iguana species and public use needs within Guanahacabibes National Park.

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Lesser Antillean Iguana (*Iguana delicatissima*)

National Actions Plan. Since 1980, the erosion of biodiversity is recognized as a worldwide environmental problem. Despite the presence of international conventions on species and habitat conservation, biodiversity remains threatened. The French Overseas Departments and Territories are particularly concerned because they include islands with very different environments and markedly fragile biodiversity.

The Lesser Antillean Iguana (*Iguana delicatissima* Laurenti, 1768) (Figure 1) is one of the “emblematic” species whose vulnerability is manifest in the French West Indies. Recognized as Endangered by the IUCN Red List of Threatened Species in 2010, this iguana is now only found on eight islands: Anguilla, Saint-Barthélemy, Saint-Eustache, Basse-Terre (Guadeloupe), La Désirade, Petite-Terre, Dominique, and Martinique (Figure 2). It is feared these remaining populations may disappear in a very short time, as was the case in Les Saintes and in Saint-Martin. A National Actions Plan for the Lesser Antillean Iguana must enable conservation of the populations that still exist in the French West Indies and restore environments that are positive for the species.

The first steps. Since 1993, local and national authorities have been alerted to the threat caused by the proliferation of the Common or Green Iguana (*Iguana iguana*) in the West Indies. In April 2006, the French State initiated the implementation of a restoration plan that later became a National Actions Plan in 2008, covering the regions of Martinique, Guadeloupe, and the collectivity of Saint-Martin. In the same year, the National Committee for the Protection of Nature (CNP) asked for the implementation of a control plan for the Green Iguana in the French West Indies. In June 2010, when the Lesser Antillean Iguana National Actions Plan was presented to the CNPN, they again asked that implementation of a Green Iguana control plan be a priority in the Actions Plan.



Figure 1. *Iguana delicatissima* female. Photo by Vincent Arenales Del Campo, DIREN.



Figure 2. The Lesser Antillean Iguana distribution (map credit: Biotope).

A complete report. The National Actions Plan synthesizes knowledge on the biology and ecology (habitat, life history, home range, diet, reproduction, etc.) of *Iguana delicatissima*, describes its distribution in the West Indies and trends in population size, identifies threats, lists action steps for the next five years, and presents an implementation methodology.

Each action step is described as a discrete unit and encompasses an implementation schedule, the technique planned to realize the action,

indicators for results, and a budget estimate. A priority rating (from 1 to 3) is assigned to each action step. For more information, download the Plan at: <http://www.martinique.developpement-durable.gouv.fr>

A long-term view. The long-term objective of the Plan is to maintain and reinforce populations on islands where the Lesser Antillean Iguana still exists. The Plan also aims to progressively increase the number of individual iguanas and occupied regions. Above everything, safeguarding the remaining *Iguana delicatissima* populations requires that proliferation of *Iguana iguana* is stopped. Beyond this main issue, it is essential that the species' environments are protected and better managed. Habitat management requires knowledge of the species' optimal needs, and therefore research projects on the biology and ecology of *Iguana delicatissima* need to be implemented very quickly. The impact of introduced species on iguanas is also an important issue in need of greater understanding. Indeed, this knowledge will enable recommendations for control of these species at sites where the Lesser Antillean Iguana is particularly threatened or where there is potential for *delicatissima* translocation. Lastly, public education and awareness is a necessary conservation tool that cannot be ignored for protection of the Lesser Antillean Iguana.

An essential partnership. Designated as the Plan's coordinator and financial administrator, the Direction Régionale de l'Environnement (DIREN) of Martinique entrusted the ONCFS of Martinique with the writing and organization of the Plan. The latter is also responsible for creating a network and generating enthusiasm among partners to facilitate better exchanges between islands and to support regional actions. Through an impetus given by the ONCFS, steering and scientific committees will govern this network. The Plan brings together many partners from Martinique, Guadeloupe, and Saint-Martin.

Considering the distribution of the Lesser Antillean Iguana, actions of the Plan must be in synergy on islands throughout the range. Indeed, the long-term objectives are reliant on an international strategy that combines management efforts across the whole divided area of the species.

A five-year plan. The National Actions Plan spans five years, terminating at the end of 2015. Annual reports are expected and will enable possible adjustments to the actions. At the end of the term, a complete assessment will analyze the

progress or accomplishments of each action step and will enable strategy realignment for action in subsequent years.

The main strategic themes of the Plan are:

1. Improve knowledge of *Iguana delicatissima*.
2. Preserve *Iguana delicatissima* populations and limit the threats to them.
3. Communicate.

The Plan is comprised of fifteen action steps aimed to produce measurable short to mid-term results.

1. Improve knowledge of *Iguana delicatissima*

A) Survey populations of *Iguana delicatissima* and *Iguana iguana* in the French West Indies.

Because of the rapid, relatively recent changes in the distribution of both iguana species, most notably the expansion of *Iguana iguana*, it is of utmost importance to redo repartition maps of the two species and hybrids. Within this action, it is foreseeable to incorporate genomic sequencing to study gene flow for the two species and hybrids.

B) Study the biology of *Iguana delicatissima* populations.

Improving knowledge of species' biology, ecology, and endangerment status for subpopulations is a major issue. Results of these studies will allow identification of the species' optimum needs, upon which subsequent actions will be based. The Plan foresees the study of population structure and dynamics (population size assessment, for example), habitat use, and breeding parameters (Figure 3).



Figure 3: Radiotelemetry is used to study iguana movements and its use of habitats. Photo by ONCFS.

C) Study the impact of major threats from invasive alien species.

The impact of predation by rats and mon-gooses on iguana eggs and juveniles will be studied. Action steps also include analysis of the interaction between *Iguana delicatissima*, *Iguana iguana*, and other alien species in terms of habitat alteration and the competition for food, nesting sites, and retreats. Additionally, elimination of species uniqueness through the threat of hybridization between the two iguana species will be investigated.

2. Preserve *Iguana delicatissima* populations and limit the threats to them

A) Conserve *Iguana delicatissima* populations which are threatened by *Iguana iguana*.

Controlling the proliferation of *Iguana iguana* will require enacting new legislation concerning *Iguana iguana*. To enable this process, a control plan needs to be written describing the situation and guide partners in regulatory actions. A draft of this document is in progress.

B) Create new populations of *Iguana delicatissima*.

Iguana delicatissima individuals should be translocated to new isolated sites to expand the number of locations and subpopulations in their range. Translocation to environments that are optimal for the species and beyond the current invasion of *Iguana iguana* can be a viable conservation tool as previously tested in Martinique on Islet Ramiers (Figure 4).



Figure 4. Nine Lesser Antillean Iguanas were introduced on Islet Ramiers (Martinique) in July 2006 (Photo by DIREN).

C) Reinforce captive breeding programs.

Develop a partnership with international institutions (Jersey, UK; Memphis and San Diego Zoos, USA) that have had experience in captive breeding of *Iguana delicatissima* in order to: 1) improve the knowledge on reproduction parameters of the species, 2) share knowledge of captive husbandry with West Indian facilities, and 3) have *Iguana delicatissima* from several geographic origins as a safeguard against catastrophic loss of some of the remaining insular populations.

D) Preserve the environment of *Iguana delicatissima*.

Actions in this area include:

- introduce an adaptive management strategy.
- reinforce the recognition of the ecological needs of the species in protected sites.
- improve existing actions, such as restoration of nesting sites.
- propose new actions for localized management plans (creation of new nesting sites, vegetation restoration, enclosure fences to protect territories occupied by *Iguana delicatissima*, e.g.).

3. Communicate

A) Education and awareness for schools, institutions, and general public.

The objectives for education are numerous. At a minimum, outreach will introduce the Lesser Antillean Iguana and its biology, bring attention to its endangerment status and the threats to the species, explain legislation, and introduce the Actions Plan and the partners involved. A communication plan was developed to guide partners in the creation of communication tools and projects to reach these objectives. Examples in the Plan address development of regional and national education programs for schools, residents, and visitors using a broad range of media, and creation of publicity materials for airports and ports to reduce further translocations of *Iguana iguana* (Figure 5).

B) Collaborate with regional and international islands.

The National Actions Plan for the Lesser Antillean Iguana was developed for the French West Indies and must now join forces with the IUCN SSC Iguana Specialist Group and partners from other islands seeking to protect the species.



Figure 5. Education exhibit on *Iguana delicatissima*. Photo by D. Laffitte, ONCFS.

Partners in Conservation: Direction Régionale de l'Environnement (DIREN, Martinique and Guadeloupe), National Hunting and Wildlife Agencies, (Martinique and Guadeloupe), International Union for Conservation of Nature (IUCN, French committee), general and regional councils, local authorities, National Forest Office, Martinique Regional Park, Guadeloupe National Park, game reserves (Petite-Terre, Saint-Martin), Littoral Conservatory, Regional Scientific Committee for Protection of Nature (Martinique and Guadeloupe), National Museum of Natural History (MNHN, Paris), Université des Antilles et de la Guyane (UAG), Iguana delicatissima group of Guadeloupe (non-profit organizations such as Le GECIPAG, L'AEVA, etc.), Tourism Committee of Martinique, IUCN SSC Iguana Specialist Group, and volunteer workers.



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2013 Taxon Report

Allen Cays Iguana (*Cyclura cyclura inornata*)

Research Update 15 to 25 May 2013. This was the 34th year of our studies of the Allen Cays Iguana in The Bahamas. With a full team of undergraduates from Earlham College and Denison University, we captured 294 iguanas (83% of them recaptures) on Leaf Cay, and 97 iguanas on U Cay (82% recaptures) (Figure 1). We have now accumulated over 7100 iguana captures in the Allen Cays over our 34-year study! See Table 1.

Table 1. Recapture information by year for Allen Cays Iguanas. Abbreviations are: caps (captures), recaps (recaptures), and Cum (cumulative). Total number of captures for U Cay is 2352 (567 + 1785) lizards, and for Leaf Cay it is 4709 (1270 + 3439). All trips for 1980 through 2000 were in mid-March. Trips in 2001 and 2002 were in mid-May and mid-June to mid-July. Censuses in 2003-2013 were also in mid-May.

Year	U Cay					Leaf Cay				
	Total caps	Total recaps	% recaps	Cum. # w/ marks	Cum. # recaps	Total caps	Total recaps	% recaps	Cum. # w/ marks	Cum. # recaps
1980	30	0	0	30	0	14	0	0	14	0
1982	43	9	21	64	9	50	3	6	61	3
1983	48	25	52	87	34	51	26	51	86	29
1986	75	37	49	125	71	79	19	24	146	48
1988	111	58	52	178	129	109	59	54	196	107
1990	113	83	74	208	212	136	81	60	251	188
1992	124	89	72	243	301	148	102	69	297	290
1993	34	33	97	244	334	94	73	78	316	363
1994	150	94	63	300	428	204	110	54	410	473
1995	123	106	86	317	534	150	125	83	435	598
1996	113	86	76	344	620	177	126	71	486	724
1998	95	79	83	360	699	205	150	73	541	874
2000	169	124	73	405	823	254	175	69	620	1049
2001 ^a	140	110	79	435	933	284	220	77	679	1274
2001 ^b	40	34	--	441	967	209	89	--	799	1363
2002 ^c	143	118	83	460	1085	350	266	76	880	1629
2002 ^d	37	34	--	463	1118	147	72	--	945	1701
2003 ^e	102	95	93	470	1213	214	204	95	955	1905
2004 ^f	124	112	90	482	1325	376	257	69	1074	2162
2005 ^g	108	96	89	492	1421	246	221	90	1093	2383
2008 ^h	114	94	82	512	1515	289	245	85	1137	2628
2009 ⁱ	81	69	85	524	1584	198	173	87	1162	2801
2010 ^j	71	55	77	540	1639	220	190	86	1192	2991
2011 ^k	77	66	86	550	1705	240	207	86	1220	3198
2013	97	80	82	567	1785	291	241	82	1270	3439

^a Excludes 1 additional capture on Allen Cay.

^b Excludes 6 additional captures (including 1 recapture) on Allen Cay.

^c Excludes 6 additional captures (including 3 recaptures) on Allen Cay.

^d Excludes 1 additional capture (a recapture) on Allen Cay.

^e Excludes 7 additional captures (including 4 recaptures) on Allen Cay.

^f Excludes 9 additional captures (including 7 recaptures) on Allen Cay.

^g Excludes 6 additional captures (including 5 recaptures) on Allen Cay; and 3 new captures on the second small cay north of Leaf Cay.

^h Excludes 3 additional captures (including 1 recapture) on Allen Cay; also includes captures in March by Chuck Knapp.

ⁱ Excludes 4 additional captures (all recaptures) on Allen Cay; and 1 new capture on the second small cay north of Leaf Cay.

^j Excludes 4 additional captures (2 recaptures) on Allen Cay; and 1 new capture on the second small cay north of Leaf Cay.

^k Excludes 7 additional captures (5 recaptures; 1 skeleton) on Allen Cay.



Figure 1. Top: Allen Cays Iguana, *Cyclura cychlura inornata*. Photo by Kat Hardy.

Bottom: John Iverson (in red) and Earlham College and Denison University students process iguana data. Photo by Natsumi Fearnside.

The sex ratio of iguanas on Leaf Cay has stabilized at near 1:1 (133 males:135 females this year; 102:101 in 2011; 92:102 in 2010). However, the sex ratio on U Cay continues to be significantly skewed toward females (37 males:52 females this year; 28:46 in 2011; 20:49 in 2010). We believe that the latter bias is in part due to the disappearance of most of the large, relatively tame males that came to the beach to be fed by tourists in recent years. For example, of 10 large males (> 40 cm body length) captured alive in 2005 on U Cay, only four were captured in 2006, two in 2008, one in 2010, and none in 2013. A decline from 10 to one in five years represents an annual survival rate of 63%, far below the long term (1980–2005) adult male annual survival rate of nearly 90%. We believe that the large iguanas were killed or removed by humans (probably between 2005 and 2006; either for food, the pet trade, or to reduce physical risk to ecotourists feeding them). This disappearance is reflected in Figure 2, that shows that the average size of the largest 10 males and 10 females from U Cay has declined significantly ($p < 0.01$) over the last 20 years.

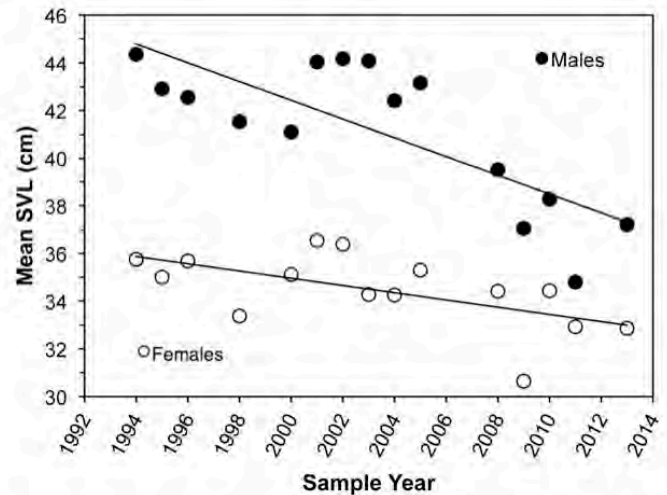


Figure 2. The average size of the largest 10 males and 10 females from U Cay has declined significantly over the last 20 years.

Ongoing New Research. For the past two years, Andrea Aplasca (Master's student at Fordham University) has been studying the population genetics of Allen Cays Iguanas based on the tissues samples exported by Chuck Knapp over the past decade. Her thesis was completed in August 2013, and her data indicate that 1) the populations of Leaf Cay and U Cay are genetically distinct, 2) the iguanas on Allen Cay are genetically the same as those on Leaf Cay, 3) most of the individuals in the introduced population on Flat Rock Reef Cay (FRRC) share U Cay genotypes (with some identical to Leaf Cay genotypes), 4) the introduced population on Alligator Cay in the Exumas Cays Land and Sea Park shares the genotype found on Leaf Cay (a result of a sanctioned translocation from there in 1988 and 1990), and 5) the genetic diversities in the introduced populations of Alligator Cay and Flat Rock Reef Cay are (thankfully) comparable to those in the natural populations on Leaf and U Cays. These results suggest that efforts should be made to insure that no iguanas are introduced to U Cay from other cays. In addition, they suggest that iguanas from Leaf Cay could be used to supplement the population on Allen Cay now that nesting habitat has been created on the latter.

But the more complicated conservation question that stems from this research is whether the U Cay population should be actively managed to maintain its previous genetic distinctiveness. This would require the immediate removal of all iguanas from U Cay without the U Cay genotype. This would be logistically very challenging, as well as very expensive, because it would not only require intensive field work to capture all the iguanas on the Cay, but also the development of

a laboratory method to genotype the iguanas in the field (while the iguanas are in hand). In addition, a decision would have to be made about what to do with any rejected iguanas, although translocation to FRRC where a mixture of all genotypes already occurs, would be reasonable.

Another Master's student (Kristen Richardson of the University of California, San Diego) has also just begun her research on the use of stable isotopes in the tissue samples of Allen Cays Iguanas to determine their dietary history. The ratios of isotopes in an animal's tissues reflect the ratios of isotopes in the organisms they have eaten in the past. Using the previously collected tissue samples, Kristen should be able to 1) quantify isotope ratios for iguanas fed by tourists (Figure 3) versus those on natural diets, 2) compare diets of introduced versus natural populations, 3) compare diets before and after translocation, and 4) look specifically at the isotope signals from the "giant" iguanas found only on Allen Cay to see if it is diet (e.g., increased protein consumption) that explains their gigantism. This research will extend over the next two years.

Pit Tags. This year we implanted an additional 40 microchip (PIT) tags in iguanas, and have now PIT tagged a total of 919 lizards in the Allen Cays (Table 2). We had one PIT tag failure this year, but the failure rate has been quite low over our 21 years of using them, as has been the failure rate of toe clips due to natural toe loss. We will continue to PIT tag as many subadults and adults as possible each year as funds allow (\$9 per tag), because the redundancy of using both methods simultaneously insures the positive identification of every iguana so marked.

Rainfall Patterns. On 18 May 2008 we deployed a digital rainfall gauge in the interior of Leaf Cay (Table 3). The logger was downloaded on 18 May 2009, and deployed again to record for the next year, but malfunctioned. The logger was re-deployed on 19 May 2010 and recorded properly until 19 March 2011 when the battery died. The unit was again deployed on 15 May 2011 and recorded until 7 May 2012 when downloaded and redeployed for the next year. It was then downloaded on 15 May 2013 (although the battery had died on 19 March 2013) and again re-deployed.

Total rainfall from 18 May 2008 to 18 May 2009 was 23.65 inches (60.07 cm), from 19 May 2010 to 19 March 2011 it was 38.91 inches (98.83 cm); from 15 May 2011 to 11 May 2012 it was 38.03 inches (96.60 cm); and from 11 May 2012 to 19 March 2013 it was 32.91 inches (83.59 cm).



Figure 3. Top: Ecotourist feeding grapes to iguanas using a stick on Leaf Cay. Photo by Lynne Pieper. Middle: If grapes are dropped, iguanas will ingest sand causing health issues. Photo by by Kat Hardy. Bottom: Earlham undergraduates educating ecotourists about iguana conservation. Photo by Lynne Pieper.

The seasonal rainfall pattern was similar in all years, with a wet season from mid-June to November or December; however, 2010, 2011, and 2012 were much wetter than 2008, primarily due to the abundant October rainfall associated with Hurricanes Otto and Paula in 2010, and Hurricane Irene in August 2011. Surprisingly, rainfall from Hurricane Sandy in October 2012 was not excessive. However, the most unusual climatic event was the anomalous excessive rainfall in April, May, and June 2012 (typically the height of the dry season).

Allen Cay Renovation Project Update. Nearly all the iguanas on Allen Cay were previously relocated to Flat Rock Reef Cay (FRRC) in 2011 and 2012 so that Island Conservation and the Bahamas National Trust could eliminate the Allen

Table 2. Tally of PIT (passive integrated transponder) tags deployed and their success rates for Allen Cays Iguanas. Abbreviations are Recaps (recaptured lizards), Cum (cumulative), True tag failures (tags palpable under skin, but no signal), and Other tag failures (tags not palpable and no signal). Data for 2001–2013 are for May captures only.

Year	U Cay					Leaf Cay				
	Number newly tagged	Cum total tagged	Recaps with tags	True tag failures	Other tag failures	Number newly tagged	Cum total tagged	Recaps with tags	True tag failures	Other tag failures
1993	5	5	0	--	--	11	11	0	--	--
1994	13	18	3	0	0	3	14	5	0	0
1995	52	70	10	0	0	19	33	8	0	0
1996	56	126	36	0	0	56	89	19	0	1
1998	0	126	57	0	3	77	166	49	1	2
2000	29	155	74	0	1	55	221	80	0	2
2001	24	179	75	0	0	14	235	93	1	2
2002 ^a	6	185	65	0	0	20	255	65	2	0
2003 ^b	14	199	58	0	0	52	307	66	3	1
2004 ^c	15	214	65	0	0	51	358	106	1	0
2005 ^d	10	224	50	0	1	52	410	105	0	1
2008 ^e	32	256	27	0	0	74	484	100	0	2
2009 ^f	8	264	41	0	2	30	514	124	1	1
2010 ^g	15	279	45	0	0	21	535	129	0	2
2011 ^h	23	302	43	0	0	42	577	135	4	0
2013	8	310	63	0	0	32	609	165	0	1

^a Excludes pit tags placed in 3 iguanas on Allen Cay.
^b Excludes pit tags placed in 5 iguanas on Allen Cay.
^c Excludes pit tags placed in 3 iguanas on Allen Cay; also excludes 7 carcasses (2 on U; 5 on Leaf) still bearing tags.
^d Excludes pit tag placed in 1 iguana on Allen Cay (total now with tags = 15); also excludes 1 of 6 carcasses (on Leaf Cay) still bearing tags.
^e Excludes pit tags placed in 2 iguanas on Allen Cay (total now with tags = 17); also excludes 3 of 9 carcasses still bearing tags.
^f Excludes pit tag placed in one iguana on Allen Cay (total now with tags = 18); also excludes 4 of 6 carcasses still bearing tags.
^g Excludes pit tags placed in 2 iguanas on Allen Cay (total now with tags = 20); also excludes 2 of 5 carcasses still bearing a tag.
^h Excludes pit tag placed in 1 iguana on Allen Cay (total now with tags = 21); also excludes 1 of 5 carcasses still bearing a tag.

Table 3. Monthly rainfall (inches) recorded in digital data logger on Leaf Cay in the Allen Cays from 18 May 2008 to 18 May 2009, 19 May 2010 to 19 March 2011, 15 May 2011 to 11 May 2012, and 11 May 2012 to 19 March 2013. Note the unusual amounts indicated in bold.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	--	--	--	--	0.34*	1.14	3.03	4.14	5.54	4.08	2.20	1.68
2009	0.84	0.51	0.13	0.00	0.02*	--	--	--	--	--	--	--
2010	--	--	--	--	0.36*	1.86	4.15	5.13	6.62	16.11	0.32	2.94
2011	0.96	0.03	0.43*	--	0.12*	2.08	1.97	6.86	6.67	6.95	2.49	1.04
2012	0.24	0.86	1.37	6.50	7.64	6.55	3.17	4.64	2.51	6.12	0.25	2.03
2013	0.02	0.39	0.47*	--	--	--	--	--	--	--	--	--

* partial month only

Cay mouse population (which was undertaken in May 2012). We had planned to spend two days this year on FRRC, locating as many of the translocated Allen Cay Iguanas as possible and returning them to Allen Cay. Unfortunately, high winds, rough seas, and rainstorms made only a dangerous two-hour visit possible this year. We did manage to locate four of the translocated iguanas during this short visit. Unfortunately, two of them had died. The other two were alive but quite emaciated, weighing about 60% of their weight when first caught on Allen Cay. We rehydrated them intravenously with dextrose solution and released them on the north end of Allen Cay where they were initially captured. We plan to return to FRRC on our next trip to locate the remaining translocated Allen Cays iguanas and return them to Allen Cay. It is our conclusion, based on the captures so far on FRRC, that temporary translocation of iguanas to other cays for more than a few weeks is not an acceptable strategy.

We did spend half a day surveying Allen Cay for evidence of iguanas that we missed in 2011-2012, but could find no sign of iguanas. However, Will Mackin did find a large fresh iguana scat on the south end of Allen Cay in May 2013 after our departure, suggesting that at least one iguana safely remained on Allen Cay through the translocation and mouse eradication process. We also spent another partial day on Allen Cay adding more sand to one of the potential nest sites that we created last year. Most of the sand from a second sinkhole that we filled in 2012 (near the landing beach) had settled far down into the sinkhole, and will have to be re-filled

with sand during our next field season. The third sinkhole we renovated in 2012 was still intact, but we will need to add some more sand to it in the future. Of course, we will monitor these sites into the future to look for evidence of nesting (e.g., old egg shells). In addition, we also intend to create more potential nest sites on Allen Cay by adding sand to other sinkholes on the island.

Bush Hill Cay (Acklins Iguana). For the tenth year (2002-2010, except 2006, 2011, and 2012) we visited Bush Hill Cay at the northern limit of the Exuma Cays Land and Sea Park to census the introduced population of Acklins Iguana (*Cyclura rileyi nuchalis*) there. During one full day on 23 May, we captured and processed 78 iguanas (23 males, 49 females, five unsexed, one carcass; seven new, 70 recaptures). We have now marked a total of 331 iguanas on Bush Hill and recorded 531 total recaptures (Table 4).

We found the carcass of a large rat (*Rattus norvegicus*?) on Bush Hill Cay, confirming the continued existence of rats on the cay. We continue to be concerned about their impact on the iguana population. Juvenile iguanas are rarely observed, and this may be due to predation on eggs and/or juveniles by rats. The extremely high frequency of iguanas with regenerated tails (and forked tails) on this cay may also be the result of attacks by rats. This year 61% of captured males, 53% of females, and 80% of juveniles had regenerated tails. This island would be a good candidate for a rat eradication program, IF the iguanas could safely remain on the cay during the rodenticide application.

Table 4. Capture information by year for Acklins Iguana introduced to Bush Hill Cay. All trips 2002-2005 were for 24 hours or less in mid-May. The 2007 trip was 1.5 days in late June. The trips in 2008 and 2011 were for 1.5 days in mid-May. Those in 2009 and 2010 were for 48 hours in mid-May, and that for 2013 was one day in mid-May.

Year	Total captures	Total adults ^a	Total juveniles	Total recaptures	Percent recaptures	Cumulative # with marks	Cumulative number recaptures
2002	75	75	0	--		75	--
2003	72	69	3	16	22	131	16
2004 ^b	104	103	1	42	40	194	58
2005	106	105	1	59	56	241	117
2007 ^b	96	93	3	58	60	279	175
2008 ^b	79	73	6	65	82	293	240
2009 ^b	75	68	6	61	81	305	301
2010	116	109	7	103	89	318	404
2011	57	54	3	51	89	324	461
2013	77 ^b	73	4	70	91	331	531

^a includes all individuals 20 cm SVL or larger (the size when the juvenile pattern begins to fade)
^b excludes single carcass found

Future Plans. Schedule conflicts in May–June 2014 will prevent me from making my annual trip to the Allen Cays in 2014. However, we are planning to resume our Allen Cay field work in May 2015.

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