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In This Issue

ISG Newsletter
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News & Comments

International Iguana Foundation Grants The International Iguana Foundation (IIF) held their annual Board meeting in San Diego on 27 April 2002. Grants were awarded for the following projects:

Enhancing in-situ captive management for the Grand Cayman Blue iguana. $10,000 awarded to the National Trust for the Cayman Islands as partial salary for an iguana facility manager. This grant can expand to $15,000 with in-country matching funds.

Conservation of the Jamaican iguana. $15,000 awarded to Peter Vogel and the Jamaican Iguana Conservation and Research Group for yearly operating expenses for the ongoing field research and recovery program.

Anegada iguana recovery program. $15,000 was earmarked to promote the recovery effort for this critically endangered iguana. The specific details of how these funds will be allocated are still being determined.

Previously in 2002 the IIF had awarded $6,500 to Byron Wilson of the Jamaican Iguana Conservation and Research Group to continue his ongoing assessment, now in its fifth year, of the mongoose removal program in the Hellshire Hills. A $1,500 grant was given to Catherine Malone to continue her iguana survey work in St. Lucia in collaboration with the Durrell Wildlife Conservation Trust. This fieldwork was also supported by grants from the Miami Metro and Columbus Zoos.

The IIF is also pleased to announce that they are the recipient of a grant from the Disney Wildlife Conservation Fund for $8,100 for *Expansion of in-situ captive breeding for the Grand Cayman Blue Iguana.* These funds are earmarked for materials needed to construct larger breeding enclosures at the Trust's iguana management facility in the Queen Elizabeth II Botanic Park. This grant brings the total to $18,100 (potentially $23,100) that has been raised through the IIF in support of the Grand

Cayman Iguana Species Recovery Plan drafted in November 2001. A third grant, seeking $21,200, was also submitted to the AZA Conservation Endowment Fund (CEF) for the proposal "Flagship Species Campaign to save the Grand Cayman Blue Iguana," by Allison Alberts, Rick Hudson, and Fred Burton. These actions illustrate the momentum that a well written and ratified Species Recovery Plan can exert toward the mobilization of resources from a diverse array of funding agencies and sectors.

Finally a $2,400 grant was awarded to the ISG by the Chicago Zoological Society's Chicago Board of Trade Endangered Species Fund to support radio-tracking projects on four species of West Indian iguanas. These funds are designated to purchase radio-transmitters for the programs on Grand Cayman, Mona Island, Andros Island, and Anegada, BVI. This grant will be matched by the IIF to provide a total of $4,800 to be divided among these projects.

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Mona Island Headstart Releases Five (3.2) 30-month old *Cyclura cornuta stejnegeri* were released by staff from the Departamento de Recursos Naturales y Ambientales de Puerto Rico (PRDNER) on 23 April near Punta Arenas, Isla Mona, with surgically implanted AVM G31V radiotransmitters coupled to K7 3.6v batteries.

This is the first release of headstarted Mona Island iguanas, an initiative led by the PRDNER and the Toledo Zoological Gardens. The iguanas were released near the nesting site from which they were collected in 1999. This is the first release of a group of 45 headstarted Mona Island iguanas, and is designed to test the size at which *Cyclura c. stejnegeri* are immune from feral cat predation and to determine dispersal distances and patterns. This initiative is led by the PRDNER and the Toledo Zoological Gardens.

On Isla Mona, pre-release medical evaluations were performed by the Toledo Zoo veterinary staff on 20 animals. Animals were physically examined, weighed, measured, and had a fecal parasite check. Many had oxyurids; all were treated twice with fenbendazole. The iguanas had a mean body mass of 1206 grams and a mean snout-vent length of 273 mm and were found to be in excellent condition. A subset of ten animals had fecal samples preserved for parasite identification and a *Cryptosporidia* IFA test; feces were also cultured for *Salmonella* and all were positive. The *Salmonella* sp. is being serotyped. Slides were made of blood for hematology. Blood samples were taken for chemistry panels, mineral analysis, and vitamin D analysis. Another subset of ten animals had only the hematology and chemistry panels run. The veterinary health assessments are being funded by a grant from the Morris Animal Foundation to the International Iguana Foundation.

We released the iguanas after three days of recovery from surgery. All iguanas have stayed within one kilometer of the release site and have been observed eating, climbing, and basking normally. A second release is schedule for August, 2002.

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Alberto Alvarez of the Department of Natural and Environmental Resources, Puerto Rico, releases the first headstarted Mona Island iguana, Cyclura cornuta stejnegeri.

Taxon Reports

Jamaican iguana (*Cyclura collei*)

Over the last few months, the Jamaican iguana project has achieved a number of break-through results:

- First confirmed nesting by repatriated headstarted iguanas.
- First hatchling born in captivity at the Hope Zoo.
- First recapture of an iguana that was captured, marked, and released as a hatchling.
- Documentation of long-term (>5 years) survival of a repatriated iguana.

During late May and June, we observed a record number of 15 females showing indication of nesting (body colored with red soil) in the vicinity of the known nesting sites. Of these females, at least four had been headstarted at the Hope Zoo. We ascertained actual nesting in 12 females including two headstarted animals. We initially observed the two headstarted females in gravid condition (body cavity expanded), digging nest holes, and subsequently in a spent condition (body cavity constricted) closing nest holes and guarding. This is the first year that we obtained definitive evidence of clutch deposition among repatriated, headstarted females.

The incubation period was extremely dry and hot, and hatching success may have been somewhat suppressed. Still, we witnessed 83 hatchlings emerging from the known nesting sites, which we had enclosed with nets and fences. Four hatchlings died under a net from a cat that attacked them in the night. Using one of the dead hatchlings as bait in a mongoose trap, we were able to capture and remove the cat the following night. We released 58 hatchlings back into the wild; of these, 34 were equipped with PIT tags, and the remainder were marked by toe-clipping (the arrival of additional transponders was delayed because of the September 11 terrorist attack). The Hope Zoo received 21 hatchlings for headstarting.

On September 2, we recaptured an iguana that we had marked and released as a hatchling at a nesting site in September, 1999. This was the first time that we have recaptured any marked hatchling, and it may signify improved survival of juveniles due to the mongoose control.

We repatriated 13 headstarted animals, seven females and six males, in February, 2001. Eight of these animals had hatched in 1993, and five in 1994. The total number of repatriated animals now stands at 39. The traps employed for mongoose control continue to be an extremely valuable tool for monitoring the Jamaican iguana population, and in particular the repatriated animals. On September 3, we recaptured the first male ever repatriated; he was released on April 1, 1996, at an age of five years. Though he appears to live within a few hundred meters of the release site, his survival had remained undocumented. Overall, we have now demonstrated survival for over two years (up to 65 months) for eight of 20 iguanas repatriated between 1996 and 1998. The first-time recapture of the male released in 1996 suggests that we may find even more animals surviving over extended periods.

An important component of the headstart-release program concerns the health screening of release candidates, to ensure that no diseases or infectious agents are introduced into the wild population. Before the 2001 nesting season, our health screens were conducted without knowledge of natural, field levels of parasites or pathogens. This June, Rick Hudson and Fort Worth veterinarian Nancy Lung traveled to Jamaica and set up a health-screening lab in central Hellshire. The purpose of this exercise was to obtain, for the first time, relevant field levels for comparison to the levels of our Hope Zoo headstart animals.

The effort was originally intended to be a trial exercise, to assess the feasibility of conducting such sampling in the remote interior of Hellshire. However, we actually managed to collect a number of samples that were then safely transported back to the US for analysis. In all, relevant samples (whole blood, blood smears, cloacal swabs) were obtained from four wild females. These data will provide the first health parameters for wild Jamaican iguanas. In addition, we collected samples from three repatriated, headstarted iguanas.

Analysis of these samples is on-going. Because iguanas at the Hope Zoo display strikingly low levels of parasitic infection (compared to wild individuals of closely related species), we suspect that the levels of wild animals will be higher, presumably because some of the intermediate parasite hosts are absent from the zoo environment. Examination of headstarted animals should demonstrate that parasite loads are acquired after release into the wild, and could possibly indicate the rate at which parasitic infection is established.

The removal of exotic predators has continued without interruption. With the exception of several traps close to the nesting sites during June, all 42 mongoose and cat traps remained baited and open continuously. We have now removed over 300 introduced carnivores (primarily mongooses, but also feral cats). As evidenced by a reduction in capture rate (roughly an order of magnitude), we are confident that our removal plot is 100% free of resident mongooses. At present, we are capturing an average of 1-2 mongooses per week, and have indications that these captures represent mainly immigrant animals. Dogs intruding into the area inhabited by iguanas remain a problem. So far, we have attempted to remove the intruders by laying out poisoned bait (and guarding it against iguana consumption during the day). We are now planning to set up live traps for dogs at critical points.

The Hellshire Hills forms part of the Portland Bight Protected Area that was declared in 1999. To date, however, no management system to conserve the site is in place. The implementation of management appears to be delayed due to conflicts among organizations that seek to obtain management responsibility for the Hellshire Hills from the Conservation Authorities.

For the first time, a hatchling emerged from an undiscovered nest at the Hope Zoo. It was found within a cage of the main headstarting facility on September 24, 2001. Several captive females had been observed digging in June. This event marks the first ever breeding in captivity of the Jamaican iguana.

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Turks and Caicos iguana (*Cyclura carinata carinata*)

In the Spring 2000 issue of the ISG newsletter, we described the *Cyclura carinata* translocation study we were about to begin in the TCI (Gerber and Alberts, 2000). Here we describe some changes to our original research plan, our progress to date, and our projected research schedule.

We originally planned to translocate iguanas from a single large cay, Big Ambergris, which is threatened by ongoing development (Gerber, 1998), to seven small cays throughout the TCI that lack feral mammals and have suitable habitat for iguanas but do not currently support iguana populations of their own. However, several unexpected developments caused us to rethink and modify this plan. First, another field team has relocated a large number of iguanas from Big Ambergris to Long Cay (Mitchell et al., 2000). Second, the Big Ambergris development has progressed much more slowly than originally projected. These changes have reduced the urgency and need to relocate Big Ambergris iguanas. As a result, we decided to use the closest, large, threatened population of iguanas to each translocation cay as the source of animals for translocation. Doing this will allow us to better maintain existing regional genetic variation within *C. carinata* (Welch et al., in press) while also providing a genetic backup for more than one threatened population of *C. carinata*. To avoid diluting genetic differences between island populations, and possibly disrupting co-adapted gene complexes within island populations, all animals moved to a given cay will come from a single source population. Big Ambergris will still be used as the source of iguanas for Six Hills, Bush, and French Cays, but now Little Water

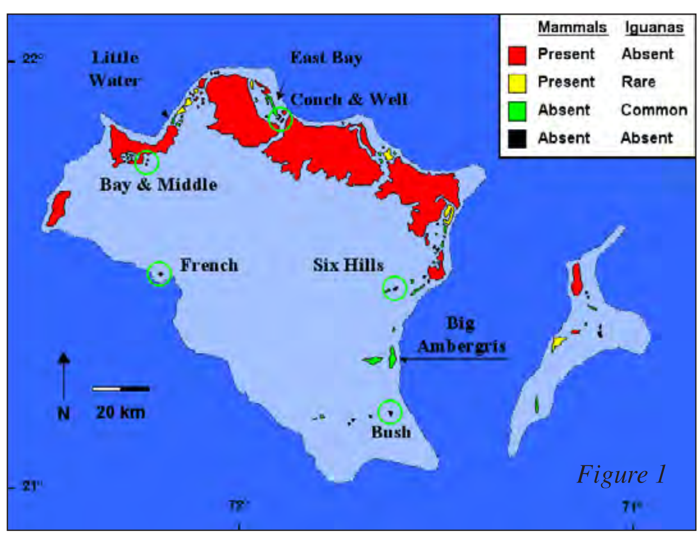

Figure 1

Cay will be used as the source population for Bay and Middle Cays, and East Bay Cay will be used as the source population for Conch and Well Cays (Figure 1).

In February, 2001, we purchased a 48-foot power catamaran in the TCI to serve as a research platform for our studies of *C. carinata*. At the time of purchase, the boat had a sound hull but was in need of a thorough overhaul. Consequently, we kept the boat in dry-dock at the Caicos Marina and Shipyard on Providenciales from March through December, 2001, for recommissioning. The overhaul included everything from hull repairs, interior and exterior refurbishing/remodeling, and new paint to the installation of new electrical, plumbing, and power generating systems. We did most of the work ourselves, with help from friends and family, and in January, 2002, the boat was launched with a new name: Cyclura. While working on the Cyclura, we also purchased and outfitted a new 16-foot skiff to serve as our project workboat.

Coinciding with work on the boats, we began preparations for moving animals to three of the cays targeted for translocation: French, Bay, and Middle. These preparations included three steps. First, each cay was surveyed with dGPS and assessed for habitat quality. This information was used to construct a GIS for each island and allowed us to better estimate the potential iguana carrying capacity of each cay. Second, data-logging weather stations that continuously record temperature, humidity, and precipitation were installed on each translocation cay and their corresponding source cay. These data will facilitate comparisons among cays and the identification of environmental factors influencing translocation success. Finally, traps for rats and cats were set on all translocation cays to determine if either of these potential threats existed.

Results of trapping on French, Bay, and Middle Cays confirmed that all three cays were free of feral cats but revealed that Bay Cay had Black rats, *Rattus rattus*. In addition, rats were trapped on three small cays adjacent to Bay Cay that are also being considered for translocation. The effect of rats on *C. carinata* populations is not known but rats occur on some of the larger cays supporting *C. carinata* populations (including the proposed source cays), suggesting that they do not pose a significant threat to iguana populations as a whole. Nevertheless, rats may pose a threat to individual iguanas, especially juveniles, and recent studies in the Bahamas suggest that populations of *C. rileyi* (similar in size to *C. carinata*) on islands with rats have lower

Aerial view of French Cay, TCI. Photo by Glenn Gerber.

densities than populations on islands without rats (Hayes et al., in press). Because of this, the decision was made to eradicate the rat populations on all four cays before proceeding with translocations. Rats were eradicated by establishing a 15-20 m grid of poison bait stations on each cay. Each bait station contained at least four 20-gram blocks of Final Blox rodenticide, which contain 0.005% Brodifacoum. Between September and December, 2002, bait stations were periodically checked and re-baited, as needed, until there was no longer any evidence of rats consuming bait and rats were no longer captured in traps. At this point, all bait stations were removed and uneaten baits were disposed of on Providenciales.

In mid-January 2002, a nine-member team assembled in the TCI to undertake our first iguana translocations. Over a two-week period, the translocation team moved 82 iguanas from Big Ambergris Cay to French Cay, and 58 and 18 iguanas from Little Water Cay to Bay Cay and Middle Cay, respectively. To maximize reproductive potential in the new populations, only adult iguanas were translocated and equal sex ratios were maintained. Prior to being translocated, all animals were sexed, health-screened by a veterinarian, marked with PIT and bead tags, measured, and bled for genetic, blood chemistry, and hormone evaluations.

Immediately following the translocations, a five-member team gathered to conduct a month of follow-up studies on the translocated populations. During this time, additional blood samples were collected from a sub-sample of each population for the analysis of stress hormones and blood chemistry studies, and data were gathered on the behavior, dispersal, and diet of iguanas on each cay. Although translocated animals were released at a single location on each cay, iguanas colonized the furthest reaches of each cay within a week or two of translocation. Over half of the translocated iguanas on each cay were observed at least once, and all animals appeared to be in good health.

Our next trip will be from mid-May through July, 2002. During this trip, we will to continue to study the newly founded populations and begin preparations on the remaining cays targeted for translocations. Future translocations are scheduled for late-September, 2002, (Six Hills Cay and Bush Cay) and mid-January, 2003, (Conch Cay and Well Cay). For the next few years, research trips are planned for January-February, May-June, and September-October. If you are interested in participating in these studies, please contact us for more information.

References

Hayes, W.K., R.L. Carter, S. Cyril, and B. Thornton. Conservation of an endangered Bahamian rock iguana. I. Population assessments, habitat restoration, and behavioral ecology. In: Biology and Conservation of Iguanas, ed. by A.C. Alberts, R.L. Carter, W.K. Hayes, and E.P. Martins. UC Press, Berkeley, in press.

Gerber, G.P. 1998. Management plan for the protection of the iguana. In: Strategic Environmental Assessment for Big Ambergris Cay, Turks and Caicos Islands, British West Indies. Coastal Systems International, Coral Gables, Florida, p.C1-C37.

Gerber, G.P. and A.C. Alberts. 2000. Taxon report: Turks and Caicos iguana (*Cyclura carinata carinata*). Newsletter of the West Indian Iguana Specialist Group 3(1):10-12.

Mitchell, N., et al. 2000. Taxon report: Turks and Caicos iguana (*Cyclura carinata carinata*). Newsletter of the West Indian Iguana Specialist Group 3(1):8-10.

Welch, M.E., G.P. Gerber, and S.K. Davis. The genetic structure of the Turks and Caicos rock iguana and its implications for species conservation. In: Biology and Conservation of Iguanas, ed. by A.C. Alberts, R.L. Carter, W.K. Hayes, and E.P. Martins. UC Press, Berkeley, in press.

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Exuma Island iguana (*Cyclura cychlura figginsi*)

In 1997, a new population of the Exuma Island rock iguana (*Cyclura cychlura figginsi*) was discovered by a John G. Shedd Aquarium iguana research team (Knapp and Buckner, 1998). This population inhabits Leaf Cay, located northeast of Norman's Pond Cay, in the central Exuma Island chain and is unique because of the inordinately large size of adults. In 1997, a male and female were captured and released that weighed in excess of eight and six kilograms, respectively. Until this discovery, the largest recorded *C. c. figginsi* was 2.8 kilograms.

This private island is actively for sale by the owner and the presence of an endangered species of iguana has resulted in restrictions on the use of the cay and/or the purchase by any potential foreign buyer. Since the iguana colony on Leaf Cay (13.5 ha) most likely represents an unauthorized translocation approximately 15 to 20 years ago, the owner mitigated with the Government of The Bahamas and agreed to finance a translocation project. Pasture Cay (5.5 ha) located 73 km north within the boundaries of the Exuma Cays Land and Sea Park was identified as a potential island for the iguana colony. The John G. Shedd Aquarium was contacted in 1999 to conduct a habitat assessment of Pasture Cay and implement the translocation program.

Pasture Cay was visited periodically from April to June, 1999, and three days in July, 2000, and May, 2001. As stated in an original assessment report, Pasture Cay offers adequate habitat and vegetation for the survival of an iguana colony. The only initial concern was the presence of the black rat (*Rattus rattus*) on the cay. A rat eradication program using poison bait stations and snap traps was initiated in May, 1999, after submitting a risk assessment and obtaining permission from the Bahamas Department of Agriculture.

Results of the Rat Eradication Program

It was difficult to assess the success of the poison bait stations since most of the poisoned rats likely retreated and died in the karst limestone once ingesting the poison. However, one rat was discovered on a beach with a sore on its right flank that appeared to be hemorrhaging. It is assumed that this rat was a casualty of the poison, indicating its effectiveness. The snap traps provided a rough estimate of rat density and were compared with other iguana-inhabited islands. Four hundred snap traps were set on Pasture Cay with a 3% kill rate (N=13). As a comparison, 24 traps were set on Bitter Guana Cay on 21 May 1999 yielding a 29% kill rate (N=7). On 8 July 2000, five snap traps were set on Gaulin Cay, killing one, for a 20% kill rate. However, I recognize that the kill rate on Pasture Cay may be comparatively low because of trap wariness on consecutive nights.

<u>Recommendations</u>

Despite the presence of rats on Pasture Cay, I recommended translocating the iguanas from Leaf Cay. The cost and time requirements associated with a total and complete rat eradication were unrealistic. More importantly, I believe that rats do not pose a significant threat to iguanas. My hypothesis that rats are not detrimental to the Exuma Island rock iguana was based on the additional rat trapping scenarios on Bitter Guana and Gaulin Cays. Gaulin Cay supports an extremely healthy iguana population, both in terms of demographics and genetic diversity (Malone et al., in press). Rats were reported on the cay in 1983 (J. Iverson, unpubl. data), again sighted by myself in 1995, and later trapped in 2000. Yet my seven years of recapture data from hatchlings and empirical observations demonstrate that successful recruitment occurs annually on the island. Bitter Guana Cay supports an iguana population below expected numbers, but it is most likely not caused by rats rather because of hunting pressure or territorial behavior induced by the large size of the cay (Knapp, 1998; unpublished data).

Charles Knapp releasing a C. cychlura figginsi *on Pasture Cay.*

Hatchling iguanas are observed on the cay at all times of the year. Additionally, based on kill percentages, the rat density on Pasture Cay appears to be low and concentrated away from potential nesting sites. Moreover, translocations of Turks Island iguana (*Cyclura carinata*) were being conducted to rat-inhabited cays in the Turks and Caicos because rats and mice were not considered a threat to those iguana populations (Mitchell et al., 2000).

No immediate threats, except human intrusion, exist for the iguanas once translocated to Pasture Cay in the Exuma Cays Land and Sea Park. A long-term monitoring program of the rats and iguanas will be conducted by the John G. Shedd Aquarium and Sandra Buckner (Chairperson of the Wildlife Committee, Bahamas National Trust) to insure that the iguana population remains viable and increases in number. The Bahamas Government has indicated that Pasture Cay (Crown Land) is to be protected under the auspices of the Bahamas National Trust and included into the conglomeration of cays officially comprising the Exuma Cays Land and Sea Park. Once the designation is made, I recommend cutting access trails across the cay to monitor the iguana and rat populations more easily. The trails should be initiated away from the edge of the water and out of sight from passing boats.

<u>Translocation Results</u>

Between 1 and 5 February, 2002, Sandra Buckner, Gregory Graham (representative for the island owner), and I carried out the translocation with assistance from Tara and Craig Dahlgren (Caribbean Marine Research Center). We intended to capture every individual on Leaf Cay, though we were unsure of the total population size because only four were spotted in 1997.

A total of 59 person hours were dedicated to searching and capturing iguanas on Leaf Cay. We observed 20 iguanas and captured 16, including one subadult. The four iguanas eluding capture included an adult, a subadult, and two juveniles. It is unlikely that we observed every iguana on the island (especially the juveniles) but we are confident that most of the animals (especially the adults) were captured.

The lizards were housed in large cloth laundry bags and placed in plastic children's paddling pools inside the mesh enclosed wet lab at the Caribbean Marine Research Center on Lee Stocking Island. An additional tarpaulin was secured above the pools to shield the animals from filtered sunlight and rain. The animals were processed at night (e.g., morphometric measurements, PIT tag injection, beading, etc.) to allow maximum search time on the island during the day. I intended to draw blood from every captured iguana but the low pressure from the checked baggage compartment on the plane pushed the rubber stopper from the bottle of necessary preservative. I was able to salvage enough preservative for four samples.

On 5 February, the lizards were loaded in the back of Gregory Graham's 31-foot boat and taken on a 1.5 hour (73 km) trip north to Pasture Cay. Beginning at 1045 hrs, the iguanas were released on the south main beach of Pasture Cay. Blood was taken from four individuals prior to their release. All animals appeared healthy and free from harm. They immediately basked, scampered into the bush, and three individuals even began feeding on Inkberry (*Scaevola plumieri*) leaves.

Observations from Leaf Cay

I note succinctly two conspicuous observations while walking Leaf Cay and analyzing sex ratio and tail break frequency data. These notes are just hypotheses and require further investigation to substantiate. Contrary to other islands inhabited by *C. c. figginsi* in the Exumas, tail break frequency was higher in males (50%) than in females (33%) and both were significantly higher than other Exuma iguana populations of high density. For example, the tail break frequency for the other high-density Exuma Island iguana populations is 14.1% and 15.7% for males and females, respectively. The frequencies for the translocated Allen's Cay iguana on Alligator Cay in the ECLSP are 0.0% and 9.5% for males and females, respectively. I attribute the low frequencies to a lack of territoriality imposed by high densities on small cays and the high-energy costs associated with territorial defense. Females have higher break frequencies most likely because of nest site defense. In contrast, iguanas on Andros display a tail break frequency of 44.4% and 38.5% for males and females, respectively. Andros is larger and the iguanas are more evenly disbursed throughout the landscape. Males have a slightly higher tail break frequency presumably because of territorial behavior absent in the Exuma populations.

The elevated tail break frequencies of males on Leaf Cay may be attributed to the skewed sex ratio (5 females, 10 males, 1 unknown; the unknown animal was counted as female in the breakage frequency percentages) and perhaps causing males to compete more aggressively with rivals during mating seasons. The low population density also may be involved in the elevated breakage frequencies. The presumed associated cost of territorial defense in the low-density colony may be sufficiently low to warrant territorial behavior. Though no aggressive behavior was witnessed, the animals (with exception of a west beach male and two females) were evenly spaced around the perimeter of the island. This spacing behavior is reminiscent of the presumed territorial Andros iguanas.

The surprisingly low population growth on the island may be a result of the biased male sex ratio. A comprehensive comparative study will be conducted on Pasture Cay and Alligator Cay to determine if rats negatively affect population growth in the translocated colony.

Acknowledgments

I thank Sandra Buckner and Greg Graham for their assistance throughout the translocation process. Tara and Craig Dahlgren provided logistical and physical support during the February capture period. The owner of Leaf Cay provided financial support for the translocation. The Bahamas Department of Agriculture and Bahamas National Trust provided the permits and permission to conduct the translocation.

References

Knapp, C. 1998. Vanishing iguanas. Journal of the International Iguana Society 7:27-30.

Knapp, C., and S. Buckner. 1998. Geographical Distribution. *Cyclura cychlura figginsi*. Herpetological Review 29:51.

Malone, C.L., C.R. Knapp, and S.K. Davis. Consequences of Pleistocene fragmentation: isolation, drift, and loss of genetic diversity in populations of the endangered Bahamas rock iguana, *Cyclura cychlura*. Conservation Genetics, in press.

Mitchell, N., M. Fulford, R. Haeffner, W. Clerveaux, and G. Mitchell. 2000. Taxon report: Turks and Caicos iguana (*Cyclura carinata carinata*). Newsletter of the West Indian Iguana Specialist Group 3(1):7-10.

BM	SVL	VTL	HW	HL	FP (R/L)	PR	Azys	Ticks
0.3	19.1	28.5	22.9	37.0	20/17	5	6	4
3.24	39.1	56.8	42.1	80.3	22/21	5	2	31
3.32	41.1	61.0	44.4	89.9	20/21	4	3	24
3.77	38.2	54.4	41.5	82.8	19/19	3	5	26
7.25	54.4	63.8	61.0	131.0	17/16	4	1	36
2.86	40.9	58.1	41.5	78.5	20/19	4	2	18
3.89	42	62.2	46.8	94.6	18/19	4	3	10
7.8	65.5	68.4	57.9	127.6	18/20	5	3	21
3.63	44.9	60.3	45.7	84.3	20/19	5	1	49
3.59	39.4	58.1	42.5	82.3	21/20	3	3	48
5.95	52.0	62.1	61.0	124.0	19/18	5	1	40
7.24	51.0	72.4	63.4	128.0	20/20	4	1	43
5.73	48.3	49.8	54.4	106.5	19/18	4	1	39
7.31	52.2	66.0	66.0	125.3	20/20	3	?	40
3.71	41.1	63.4	48.0	93.6	19/19	4	2	26
3.82	44.4	62.8	46.9	93.6	21/21	5	3	36

Appendix. Data for Cyclura cychlura figginsi *translocated from Leaf Cay (NE of Norman's Pond) to Pasture Cay in the Exuma Cays Land and Sea Park (1 to 5 February 2002).*

BM=body mass (kg); SVL=snout to vent length (cm); VTL=vent to tail length (cm); HW=head width (mm); HL=head length (mm); FP=femoral pores; PR=prefrontal rows; Azys=azygous scales.

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Bartsch's iguana (*Cyclura carinata bartschi*)

Four days and three nights were spent on Booby Cay from 9-21 March, 2002, by ISG members Joe Wasilewski, John Bendon, and Steve Conners. One day was spent walking over the entire island (ca. 75 hectares), observing the iguanas, vegetation, the general state of the cay, presence of goats, and whether any changes in size or salinity to the saline lakes were apparent.

A small pond, about 12 meters x 4.5 meters, was observed at the northwest corner for the first time. The large lake at the eastern end appeared similar in size as it did last year and the salinity was greater than the sea, owing to evaporation. The two small, long, thin middle lakes had dried up, there was an abundance of *Sessuvium* among the ironstone plates, and many iguanas were spotted. This area is now named 'Rocky Pond' and four iguanas were caught, tagged and beaded in this area. The lakes shrink and grow according to the weather and are normally fuller in Oct/Nov than in March, when they are noticeably drier.

Stories abound about the goats among local fishermen. Sizes of herds are about 15 animals. One herd of 17 was seen, including three kids. Estimates range from a highly improbable 200, to 150, 100, and 50. The Booby Cay team feel that 50 is a much more realistic figure, as more would have been spotted if the number was very high. The police on Mayaguana are aware of the desire by the authorities and wildlife and botanical organizations to rid the cay of the goats. I was approached by the constable, who stated they were willing to go to the cay and shoot as many as possible while I was still on Mayaguana. They do not know where the herds are and will need assistance. Our opinion is they will need more money than is available because it will take more than one or two trips to do the job. One fisherman with a gun, boat, and three helpers has asked for $1000 US to eradicate the goats.

Unfortunately, the prickly pear, *Opuntia millspaughii,* which was previously infected with the larvae of the South American moth *Cactoblastis cactorum* was again observed with possible infections that seemed to be more prolific than before. This time though, one of the other cacti, *Melocactus*, the Turk's Cap, was also in a similar state. It is not yet known if this is indeed the same parasite, a natural die off, or from some other cause. It was not a question of the cap (flower) dying and shrivelling - the entire cactus was empty. The rest of the vegetation was fine. The *Sessuvium* was growing voraciously, the seven-year apple was prolific, and I found a three-foot high coconut palm, a first observation here. On the mainland of Mayaguana, it was no surprise to see 'fatal yellowing' on some of the palms. This is happening throughout Florida and parts of the Caribbean.

The following is a personal communication with Henry Alexander Charlton, 82 years old, the great grandson of Abraham Alexander Charlton, founder of Abraham's Bay Settlement on Mayaguana in 1881. Mayaguana is apparently named as a mixture of 'Iguana' and the month of May, the time of arrival. Abraham found the then unnamed island of Mayaguana, but actually lived on Booby Cay (still called Guana Cay by old locals). He came from the Dominican Republic, apparently bringing with him a few iguanas, implying that he more likely stopped over somewhere on the Turk's and Caicos Islands first, as there are no *Cyclura cornuta* on Booby Cay. He apparently farmed, grew spices, and had a few goats. He then moved over to the mainland, opposite the cay, and established a plantation almost at the tip. Although the Booby Cay team searched that area, no iguanas were found. I have now been told by Henry Charlton that there are iguanas about half a mile west of the easternmost point on the north side, but this communication must be regarded as anecdotal until verified.

We spent four days on the cay. On the day spent walking it, only four of the 1999 beaded iguanas were seen. One was seen in November, 2001, which was a good six hundred yards from where it was originally captured and released. A new map is being prepared, showing only sites where iguana tracks were seen. Surprisingly, this covers an enormous area of the cay. The team did not attempt to capture and bead many animals, and only twelve lizards from four different locations were processed. One previously transpondered iguana was found as well, appearing close to death: spines missing, emaciated, very slow-moving and showing bite-marks. It was not seen again. Of the twelve iguanas processed, the two heaviest weighed 1700 grams, the lightest 650g. The female iguanas were noticeably fatter than in our previous November trips, perhaps because the females are preparing for mating and egg production. At the fishermen's camp on the south side, many yearlings were seen, and two-year-olds were hovering around the conch shells and cooking pots, scavenging for scraps. There seem to be far more iguanas in these woods than territorial behavior would allow, suggesting that perhaps territoriality may disappear when food supplies are abundant. No iguanas at this camp were seen chasing each other; however, many new tracks were seen that could possibly be evidence of the 'Tango' behavior I have previously reported, suggesting that this goes on all year.

Juvenile Cyclura carinata bartschi *on Booby Cay. Photo by John Bendon.*

Glenn Gerber suggested that about 1000 iguanas are present on the cay based on studies undertaken over a three-day period in 1999. We feel that perhaps 700 is a nearer estimate until the cay can be surveyed in its entirety. Another color variation of iguana was noted, predominantly speckled white against black (see photo). Of course this may be just individual variation as only two or three juveniles were spotted like this. All of the juveniles were very tame that lived behind the fishermen's 'kitchen' in an area of glades where the sunlight comes through in speckles, creating whitish spots on the ground similar to the iguanas' coloration.

Sadly, the presence of cats was noted by the team on the mainland opposite the cay, three hundred yards away separated by a shallow causeway. A more extensive cat survey will not be made in November 2002, as we know they are all over the mainland. This trip was supported by the Miami Metro Zoo Conservation and Research Fund.

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Cuban iguana (*Cyclura nubila nubila*)

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Potential Uses of the Cuban Iguana

Today it is recognized that all species of a country have many useful values (direct and indirect) in addition to passive existence (Heywood and Watson, 1995), and that in many cases, to emphasize and to promote the useful values of a certain species could help in its conservation (Webb, 1999) although not always (Caughley and Gunn, 1996). If use is decided, it must be sustainable in four aspects: demographic, ecological, economic, and social (Prescott-Allen and Prescott-Allen, 1996).

From our native ancestors to present day fishing communities, the Cuban iguana (*Cyclura nubila nubila*) has constituted, and still constitutes today, a valuable natural resource, mainly as a source of meat for subsistence. This use, combined with the elimination of its natural habitat in general, has caused the extirpation or reduction of numerous populations of the species. At the moment, the Cuban iguana is relatively abundant only in certain coastal localities of the island of Cuba and some surrounding cays (Hudson et al, 1994; Berovides et al, 1996; Perera et al, 1996). Its total population is estimated to be 40,000 to 60,000 individuals (Perera et al, 1996) and its conservation status is listed as Vulnerable by the IUCN (Berovides et al, 1996).

Five potential commercial uses for the Cuban iguana are recognized. They include the commercialization of its meat and skin, the sale of juveniles as mascots or pets, adult samples mounted by taxidermy, and exhibition for ecotourism. The first four uses are consumptive, in the sense that individuals must be extracted from the population, whereas use for ecotourism is non-consumptive. In the first case, for use to be sustainable (from the point of view of demographic sustainability) the quantity of animals extracted must not jeopardize the replacement rate of the population, should not cause environmental damage (ecological sustainability), must be economically profitable (economic sustainability), and must benefit the local communities (social sustainability).

In our opinion, the Cuban iguana has certain advantageous qualities that make it potentially commercializable. These include:

- Meat and skin are supposedly of good quality, but not yet rigorously evaluated.
- Herbivorous and therefore relatively easy to maintain.
- Juveniles are attractive and easy to maintain.
- Adults are large and showy, worthy of observation, and make good exhibit animals in captivity.
- Ample geographic distribution throughout Cuba, and in some zones populations are relatively abundant. At the present time, 11 population centers are recognized for the species (Perera et al, 1996), distributed throughout the Cuban archipelago.
- Relatively high densities, from nine to 25 adult iguanas/ha in some locations.
- Elevated reproductive capacity.
- Picturesque habitat; accessible and with good visibility for observation and study.
- Limited resources (food, refuges, and oviposition sites) that are easily manipulated.

The negative aspects for the commercial use of the species include:

- Slow growth
- Little is known of its life history to be able to implement realistic management plans.
- Long life span.
- Low rate of recruitment of populations, due to the high juvenile mortality.

All the above aspects must be considered when evaluating the iguanas for their different uses.

The Cuban Iguana as a Mascot or Pet

Juvenile Cuban iguanas are sufficiently attractive to serve as mascots or pets in the international market, as is true of many other iguanids. However, the sustainable exploitation of iguanas for this purpose must consider the following aspects. In contrast to the relatively low mortality rate at hatching (between 14 and 22% for three species of *Cyclura*: Iverson, 1979), the mortality rate of young between one and three years of age seems to be high (45% for *C. carinata*: Iverson, 1979; 95 to 97% for *Iguana iguana*: Werner, 1991). This is expected given the longevity of adults. It implies that an appreciable quantity of juveniles could be harvested with minimal impact on the population. As indicated by Beissinger and Bucher (1992), when juveniles are harvested, the maximum sustainable harvest lies near K (carrying capacity) and not at one-half K, as when adults are harvested. Iguana species tend to be K-selected (Pianka, 1970), therefore, if populations are not altered, they must be stable and at equilibrium in their natural habitats.

Considering all these facts, it is then possible to experiment with the harvest of juvenile iguanas using three models, which vary in terms of their expense. The first is a conservative model of sustainable harvest (Beissinger and Bucher, 1992) that consists of artificially increasing K and harvesting the excess produced by this increase. For Psittacines, K can be increased by the addition of a limiting key resource, in this case nest building sites. It is enough to add nest boxes and the population will be increased, allowing the harvest of the excess individuals. For populations of iguanas, the limiting resource, in our opinion, is refuges for local and immigrant juveniles. Iguanas are herbivorous generalists (Berovides, 1980; Perera, 1985) so they are possibly more limited by refuges than by food, which is known to regulate population size in other groups of animals (Beck, 1995). It is well known how rapidly juvenile iguanas will occupy artificial refuges (Carey, 1975; Iverson, 1979, personal observations) which strongly suggests that this is a limiting resource. Similarly, as with nest boxes in the Psittacines, the addition of simple artificial refuges (as long as they are accepted) could in theory produce a sustainable harvest in juveniles, because these would be taken from the artificial refuges, and would represent the excess of the population that is normally lost to mortality.

Two other models require expensive facilities and a minimum level of knowledge about the reproduction, development, and maintenance of juvenile and adult iguanas in captivity. First, eggs can be collected and artificially hatched and juveniles hand-reared in iguana farms. In this case, nests would be collected from certain populations in the wild, and under a controlled regime eggs would be hatched and the juveniles raised, retaining close to 40% while releasing the rest to the wild once they are well developed (three years), thus simulating what happens in nature. A similar method has been suggested by Werner (1991) for *Iguana iguana*. Lastly, a final model maintains wild-caught breeders in captivity. These breeders would produce young for sale, and be replaced when necessary. We do not consider the production of juveniles in a closed cycle in captivity very economical, given the delayed sexual maturity of these animals (6-7 years in *C. carinata*, Iverson, 1979) and the general difficulties of raising large iguanids (Werner, 1991).

<u>The Cuban Iguana as Meat and Skin Producer</u>

Unquestionably the most valuable commercial product derived from the iguana is its meat, considered a true staple by many indigenous communities in the Americas, including our pre-Columbian natives. The food value of the iguana's meat makes it one of the preferred staples within the subsistence economy of natives and farmers of Latin America, especially species from the genera *Ctenosaura* and *Iguana* (Werner, 1991; Ojasti, 1993). The commercial use of iguanas seems complicated, since it must also be considered subsistence use. In Cuba, consumption of iguana meat is not very widespread, but certain fishing communities exist that do practice it for subsistence. Many other communities do not consume this species based on unfounded superstitious beliefs, as referred to by Barbour (1945), that suggest that when iguanas are hunted they emit a dark fluid reminiscent of the black vomit of yellow fever victims.

This use for subsistence, connected to the elimination and/or alteration of its coastal habitats, has caused the reduction or extirpation of populations of the Cuban iguana in some areas. Cases known to us are those of the Península de Hicacos (extirpation) and Cayos San Felipe (reduction).

Nevertheless, in spite of the high commercial value of iguana meat, a serious attempt at commercialization has never been made, except for the case of *Iguana iguana* in Central America (Werner, 1991). We do not know of any nutritional studies that have determined the value of fat, minerals, and protein of this meat compared to other species exploited for the same aim.

The consumed parts of the iguanas, at least in Cuba, are usually only the thighs and the base of the tail, those parts with the greatest mass of muscle, but this does not prevent the use of other parts, like the flanks and anterior extremities. The Cuban iguana develops to a good size and weight, especially the males, who differ significantly from the females in all standard linear dimensions and mass (Perera, 1984; González et al, in press; table I). The yield from the consumable part of the iguana (in our case the thighs and the base of the tail with a length of 15 cm) is calculated as: (consumable meat/live weight) x 100. We found slight differences in yield that were insignificant ($p>0.05$) between season of the year and the two sexes, although there was a tendency for yield to be greater in the rainy season and between males (Table II). Perhaps in this case the differences were not significant due to small sample size as the difference between sexes was almost significant ($p<0.10$).

The iguana's skin is also used by indigenous communities and farmers for subsistence (Ojasti, 1993) but we are unaware of any commercialization, as has been done with the *Tupinambis*, for example. In Cuba, the skin of *C. nubila* has been processed and apparently is of good quality, but this has not been valued objectively.

In theory, iguanas can be exploited for their meat and skin sustainably, under the same principles used with other species for the same aim: selecting adult animals under r (the instantaneous rate of increase of the population, Caughley, 1977). We have estimated the value of r for an introduced population of 12 Cuban iguanas, which after 12 years were estimated to be about 20 individuals (Nt). Assuming no migration, r is estimated to be 0.042 (4.2%). This means that, in theory, for ranching to be sustainable, no more than 4% of the adult population should be extracted. This number is logical if one considers the longevity of these animals and their low recruitment rate, and indicates how ineffective harvesting would be from a single population in terms of sustainable extraction of adults, unless the population is relatively large. Werner (1991) has proposed several methods of management for exploitation of *Iguana iguana* that obviate this problem. In that case, adults extracted from the population, no matter what their number, were replaced by captive raised juveniles. The extraction of adult Cuban iguanas based on captive raised juveniles is not economically feasible.

The Cuban Iguana in Taxidermy

The large examples of male iguanas, if they are well prepared by taxidermy, constitute spectacular and attractive ornaments that can be commercialized. Extraction of these large dominant males for this aim, in principle, would not greatly harm the population on the basis that these males would be old and have very low fertility. Under the polygamous system of the species, old males would also be preventing access to females by younger males, as well as being genetically over-represented, which lowers the effective population size. Temporary removal of dominant males has been suggested by Alberts et. al (2002) as an emergency conservation measure. Still this should be studied, because demographic effects may be long term. If this

	Males (N=15)		Females (N=22)		Total (N=37)	
Variables	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Mass	1723.33	489.84	1005.13	301.94	1245.2	533.44
Snout-Vent Length	37.76	2.71	31.32	4.48	32.88	4.66
Tail Length	47.72	7.87	36.76	5.70	41.71	8.22
Head length	7.16	0.61	5.57	0.74	6.01	1.05
Head Width	4.91	0.61	3.84	0.50	4.03	0.72
Femur Length	9.04	0.95	7.77	0.74	8.24	1.15
Humerus Length	4.25	0.52	3.54	0.56	3.93	0.72

Table I. Body mass (g) and measurements (cm) of the iguanas of Cayo del Rosario, Los Canarreos archipelago, Cuba. All body measurements and mass differ significantly between sexes ($p<0.001$).

	Rainy Season			Dry Season			Total		
Sex	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Male	7	22.57	3.91	7	20.60	2.09	14	21.61	3.16
Female	3	19.58	2.43	13	19.87	2.35	16	19.82	2.28
Total	10	21.71	3.66	20	20.13	2.23	30	20.66	2.83

Table II. Edible parts yield (%) of Cuban iguanas on Cayo del Rosario, Los Canarreos archipelago, Cuba.

method were implemented for the commercialization of large males, an in depth experimental study would be needed beforehand, to determine its short and long term effects on the reproduction, social behavior, and genetic variability of the population.

The Iguana and Ecotourism

The iguanas of the Caribbean in particular offer enormous potential for use in ecotourism as a charismatic species, and in fact are already utilized in this way in Cuba and the Bahamas, among other countries. If we consider nine aspects of the habitat and the biology of iguanas that connect them with ecotourism, we see that practically all are evaluated positively. These aspects are:

- Habitat: attractive and accessible
- Endemism: The genus *Cyclura* is endemic to the Antilles and each island has 1-2 species or endemic subspecies.
- Detectability: they are large animals and in open habitat, therefore easily detectable.
- Abundance: usually they occur in high density, mainly in rocky sites.
- Daily activity: they are diurnal animals.
- Appeal: they are active, herbivorous, and with many easily observable behavioral patterns.
- Relation with man: utilized by humans for their meat, skin, and as a mascot; source of legends.

Male Cuban iguana, Cyclura nubila nubila. *Photo by Andy Phillips.*

The only two negative aspects in relation to ecotourism for the iguana are:

- Stationary: little activity of adults on cold days and months.
- Conservation: species threatened by extinction, perhaps should be protected and not harvested.

In 1999, we made a visit to the Centro de Turismo Internacional de Cayo Largo, located south of the province of Matanzas. One of the varied activities offered by this center is a visit to Iguana cay, a small cay (2.6 hectares) populated by 70 iguanas which can be observed in the typical vegetation of grass and shrubs. This tour began in 1985 and the prices have varied. The present cost is $12 (USD) per person. The present rate of daily visitors is a minimum of 200 people per day, 340 days of the year, for a total of 68,000 visitors per year. At this price, the practice of observing iguanas is predicted to generate a gross annual income of $816,000 (USD). The 70 iguanas on exhibit today have an annual value of $11,657 USD each and a lifetime value of $104,913 USD (assuming a longevity of 9 years). Similar numbers were registered by Munn (1992) for the macaws of the Manu Reserve in Peru ($750-$4,700 USD per year and $22,500 - $165,000 USD per lifetime) but are far below that indicated for a lion in Kenya ($2-3 million USD per lifetime, Western and Henry, 1979).

The animals on the cay are apparently normal. They seem fit and healthy, although their normal vegetarian diet is now supplemented with bread supplied by the tourists. They are completely tame, but are not easily touched and apparently exhibit all their behavior patterns normally. No study currently exists on this population, its habitat, and the impact that this type of use causes. Of particular interest is the bread diet supplemented to the animals and the continuous and numerous presence of tourists. Alberts (2000) has discussed the use of iguanas for ecotourism in the Caribbean. An ecotourism plan should minimize negative impacts on the habitat, contribute to species and habitat conservation, provide environmental education for the visitor, monitor the population and the habitat, and generate benefits to the community. Visitors should also be in small groups that are not allowed to feed the iguanas (it alters their metabolic balance), and not occur during the reproductive season. None of this is fulfilled for the iguanas of Cayo Largo. Here, as in almost all the situations of biological resource use, the criterion of high short-term gains predominates, at the cost of damage in the long term. This problem is discussed by Caughley and Gunn (1996) and throws doubt on whether use of the species for ecotourism, though non-consumptive, is always sustainable.

Non-monetary Value of the Cuban Iguana

Up to now we have spoken of the monetary value of the Cuban iguana, but this species also poses other use-related value that cannot be directly converted into economic terms. Particularly, Cuban iguanas may have ecological value as a key species in coastal ecosystems, since apparently they can influence the generation and/or dispersion rates of some plant species, by passing seeds through its digestive tract (Iverson, 1979), a question not yet well studied. Finally, in addition to the anthropocentric and ecocentric values of our iguana, we wanted to add that it has biocentric value, that is to say, it has intrinsic value. By being biologically unique, the iguanas along with us and the rest of the million species that populate this planet, has the right to survive regardless of its other values. If we can preserve the iguana using the approaches described here, we may obtain the necessary balance so that hungry people fill their stomachs while those that have plenty can enjoy the iguanas.

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Recent Literature

Alberts, A.C., J.M. Lemm, A.M. Perry, L.A. Morici, and J.A. Phillips. 2002. Temporary alteration of local social structure in a threatened population of Cuban iguanas (*Cyclura nubila*). Behavioral Ecology and Sociobiology 51:324-335.

Alberts, A., and R. Hudson. 2001. Iguana. Pp. 598-603. *In*: C. Bell (ed.), Encyclopedia of the World's Zoos. Fitzroy, Dearborn, Chicago.

Lemm, J. 2002. Anegada's forgotten iguana. ZooNooz: Zoological Society of San Diego 75(3):20-21.

Rehák, I., and P. Velensky. 2001. The biology and breeding of the Cuban ground iguana (*Cyclura nubila*) in captivity. Gazella: Zoo Praha 28:129-208.

Romero, L.M., and M. Wikelski. 2001. Corticosterone levels predict survival rates in Galápagos marine iguanas. Proc. Natl. Acad. Sci. 98:7366-7370.

Wikelski, M., C. Carbone, P.A. Bednekoff, C. Choudhury, and S. Tebbich. 2001. Female choice in marine iguana leks: a wider selection of males obtained at a cost. Ethology 107:623-638.

Wikelski, M., L.M. Romero, and H.L. Snell. 2001. Marine iguanas oiled in Galápagos. Science 292:437-438.

Wilson, B.S. and P. Vogel. 2000. A survey of the herpetofauna of the Hellshire Hills, Jamaica, including the rediscovery of the blue-tailed Galliwasp (*Celestus duquesneyi* Grant). Carib. J. Sci. 36(3-4):244-249.

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