



iguana specialist group

# NEWSLETTER

*Volume 15 · Year 2015*



*Roatán Spiny-tailed Iguana (Ctenosaura oedirhina):  
See page 16 for an update on research and  
conservation in the field*





*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.*



## ISG Updates

Updates from the Co-chairs and Program Officer .....	3
2015 ISG Meeting Summary .....	4
International Iguana Foundation Social Media Updates .....	5

## Iguana News

Bahamas Expands Marine Protected Areas by 4.5 Million Hectares .....	7
The Animal Extinction Song .....	7
A New Lease on Life for Endangered “Neon Dragons” of Fiji .....	8
Iguana Captive Breeding Program in Fiji Posts First Positive Results .....	10

## Taxon Reports

Oaxacan Spiny-tailed Iguanas ( <i>Ctenosaura oaxacana</i> ) .....	11
Roatán Spiny-tailed Iguanas ( <i>Ctenosaura oedirhina</i> ) .....	16
Hispaniolan Rhinoceros Iguanas ( <i>Cyclura cornuta</i> ) .....	18
Allen Cays Rock Iguanas ( <i>Cyclura cyclura inornata</i> ) .....	22
Sister Islands Rock Iguanas ( <i>Cyclura nubila caymanensis</i> ) .....	26
Anegada Rock Iguanas ( <i>Cyclura pinguis</i> ) .....	29

Recent Literature .....	32
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ISG Contact Information .....	34
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### Updates from the Co-chairs and Program Officer

The ISG expanded our group in 2015 by welcoming Ashley Campbell and Jane Haakonsson for the remainder of the 2013–2016 term. We now have 93 members from 25 countries, including Puerto Rico. ISG members have broad skillsets that can advance iguana conservation. During their four-year terms, members are expected to contribute to the group either through (but not limited to) actively participating at group meetings, contributing to Red List assessments, organizing task teams, drafting group policies, serving on subcommittees, and/or contributing computer or artistic skills when needed. The ISG is such an impactful and successful working group because of contributions from its members. We thank you and look forward to continually improving the efficacy of the ISG as a conservation group and an integral part of the IUCN Species Survival Commission.

The website content continues to expand with resources for members and the public, including updates on field research and news, sampling protocols, and taxon accounts. The Virtual Library now contains over 2,050 iguana-specific articles, from peer-reviewed journals, grey literature, websites, and now many presentations from our ISG meetings. The website has reached over 9,300 users worldwide. We are encouraged that 25% of site visitors click on the "contribute" page that highlights our relationship with the International Iguana Foundation and provides an opportunity to donate to iguana conservation projects.

We also increased the number of iguana action plans available through the IUCN Main Library, which increases our exposure within the global IUCN network. We have included archival action plans by incorporating new cover pages that demarcate them as IUCN SSC ISG products.

In March 2015, members of the ISG translocated 27 White Cay Rock Iguanas (*Cyclura rileyi cristata*) from White Cay, southeastern Exuma Cays (The Bahamas), to an undisclosed cay within the proposed expanded boundaries of the Moriah Harbour Cay National Park. The purpose of the translocation was to establish a viable, secondary population of this Critically Endangered subspecies. The translocation augmented the nine iguanas that were introduced to the new cay in September 2014 after being confiscated at Heathrow Airport and repatriated to The Bahamas earlier that year (see ISG [Newsletter Volume 14](#)).

The ISG continued to struggle with issues of illegal trade in iguanas. In 2011 and 2012, Galapagos Land (*Conolophus subcristatus*) and Marine (*Amblyrhynchus cristatus*) Iguanas were smuggled out of Ecuador and into Switzerland, through Mali. In 2014, the Swiss CITES management authority issued export permits for these iguanas to be moved to Uganda. The United Nations Environment Programme – World Conservation Monitoring Centre CITES trade database confirms that Ecuador has never declared export of live specimens of either of these species for commercial trade, thus this exportation from Switzerland effectually laundered these species into the pet trade. In September 2015, a Mexican national was arrested in Ecuador for attempting to smuggle additional Marine Iguanas to Uganda.

Fijian Crested Iguanas (*Brachylophus vitensis*) are listed as Critically Endangered on the Red List and are CITES Appendix I. Populations on most islands within its range continue to decline due primarily to habitat destruction and invasive predators. The Monuriki island population was prioritized for protection in a Species Recovery Plan (2008) because it is genetically unique and highly threatened. In 2010, it was agreed that a subset of the remaining iguanas on Monuriki would be removed for captive breeding, while the island's habitat was restored. In May 2015, following successful restoration of the island's habitat, 32 captive-bred offspring were released back to the island in an event that brought the community together. Post-release monitoring revealed the iguanas in healthy condition. This is a significant step forward in iguana conservation in Fiji and we hope that additional populations can be restored following this method. See Iguana News, this issue, for the press release.

ISG members continued to invest a considerable amount of time providing science-based information to environmental advocates campaigning to change the location for a massive transshipment port proposed in Jamaica. This development will heavily impact the only habitat of the Critically Endangered Jamaican Iguana. We worked with the IUCN Director General and SSC Chair to deliver a letter outlining our concerns regarding the project to the Jamaican Government, as well as the development company backing the proposal. We also contributed information intended for the general public in order to inform the debate concerning the impacts that the port would have on endemic and endangered wildlife and habitats in this protected area. We supported the development of a beautiful [video](#) as an informational and fundraising tool. The campaign is supported by several high profile Jamaican musicians and businesses. A website is maintained as

a repository of information for stakeholders on this issue ([www.SaveGoatIslands.org](http://www.SaveGoatIslands.org)).

Throughout 2015, ISG members worked on drafting, reviewing, and editing a compilation of 18 research papers for a monograph titled *Iguanas: Biology, Systematics, and Conservation*, which is due to be published in the online journal *Herpetological Conservation and Biology*. The compilation highlights the diversity and unique ecology of iguanas, while emphasizing the threats to their survival and need for conservation action. Twenty-nine of the 69 authors (42%) contributing to the collection are ISG members. As editors, the three of us, plus ISG member John Iverson, are extremely grateful for all the hard work and patience of the contributors and reviewers involved in this monograph!

In September 2015, we attended the 3rd IUCN SSC Leaders' Meeting, held in Abu Dhabi. Support for this meeting came from a restricted fund of the Environment Agency of Abu Dhabi. This meeting allowed us to interact with members of other Specialists Groups as well as those involved in other aspects of the IUCN. In particular we discussed our invasive iguana position statement, recent iguana smuggling events, and the importance of information exchange within the IUCN. A number of new tools and procedures for working with Red List assessments were also introduced during the meeting.

The International Iguana Foundation (IIF) has a long-standing commitment to support iguana-related research, guided by members of the ISG and others. We recently helped to update the IIF Grant reporting format, and beginning with this edition will be sharing these edited reports (found on the [IIF website](http://www.iif.org)) within our newsletters. This will ensure that the ISG community is aware of the most up-to-date research and management actions for iguanas.

All our best,  
Chuck, Stesha, and Tandora



Tandora Grant, Chuck Knapp, SSC Chair Simon Stuart, and Stesha Pasachnik at the third SSC Chairs' Meeting in Abu Dhabi. Photo by Rachel Roberts.

## 2015 ISG Meeting Summary

The 2015 annual Iguana Specialist Group meeting was held from 10–13 November at the Guana Tolomato Matanzas National Estuarine Reserve near St. Augustine, Florida. The working meeting was our focus for the first two days, with a record 27 oral and seven poster presentations by ISG members and collaborators. By holding the meeting in the U.S. with relatively low costs, more of our members were in attendance, as well as a large number of students, totaling a record 64 participants.

While there are no native iguanas in Florida, there are several introduced invasive species, making it an appropriate setting for one of the major discussion topics during the meeting. Several presentations highlighted problems associated with non-native populations of the Common Green Iguana (*Iguana iguana*). With input from the subsequent discussion, a sub-group developed a position statement on the threats of invasive iguanas to be distributed to island countries that are particularly vulnerable.

An entire day was devoted to reviewing the Red Listing criteria, procedure, and new features in the assessment software. Attendees worked in small groups to draft ~14 assessments. Additionally, a sub-group brainstormed on future plans to revise the recovery plan for Fijian Iguanas, which will also include the other species not previously covered in the 2008 plan for *Brachylophus vitiensis*. We ended our meeting with a visit to the St. Augustine Alligator Farm Zoological Park, which is the only facility in the world exhibiting living specimens of all 24 currently recognized crocodilian species.

We thank ISG members who contributed to the travel fund. The extra donations were critical for student travel support and under-funded collaborators. The ISG considers it a priority to provide meeting access to students, and members from range countries who do not have the financial support to attend our annual meeting. Their participation is crucial for conserving iguana species long-term. We congratulate the 2015 awardees: Ashley Campbell, Giuliano Colosimo, Jeffrey Corneil, Amnerys González Rossell, Daisy Maryon, Jeanette Moss, Thijs van den Burg, and Rachel Welt. A list of meeting attendees, abstracts, and photographs can be found on our website: <http://www.iucn-isg.org/about/isg-conferences>.

In 2016, our annual meeting will return to Fiji because of our ability as a group to contribute significantly to timely in-country conservation efforts for iguanas. Our contributions will include reviewing conservation actions to date (Malolo captive population, Monuriki restoration,





Attendees at the 2015 ISG meeting Guana Tolomato Matanzas National Estuarine Reserve, Florida. Photo by Thomas Wiewandt.

etc.), discussing new data acquired since our last meeting in Fiji (2004), and developing/reviewing a new recovery plan for all Fijian iguana species to cover the next five years (2017-2022). We thank Robert Fisher and Kim Lovich in advance for organizing the meeting.



## IIF Social Media Updates

Sharing "Notes from the Field" via the International Iguana Foundation [Facebook page](#), continues to be an extremely popular way to connect people to iguana conservation efforts. Seeing IIF grant recipients and others in the field is a powerful way to engage the public and inform them on the challenges the iguanas, and the researchers face.

### Social Media Following

By year's end 2015, our Facebook following grew to 11,300. It continues to be the most effective way to spread information. Instagram has also been gaining in popularity. The IIF Instagram account, @Iguana\_Foundation, has over 700 followers and can be more effective than Facebook at times. Like Facebook, great photos and videos go a long way on this platform. Our Twitter feed has cleared 800 followers and is a great way to disseminate iguana conservation information in real time, as well as interact with followers and partners. Researchers and students are increasingly sharing on Twitter. For instance, live Tweets from attendees of #JMIH15 (Joint Meeting of Ichthyologists and Herpetologists) this year were lively and engaging!

Remember to Like and Share posts, and send us content! Help us help you!

Country	Your Fans	City	Your Fans
United States of America	5,215	Mexico City, Distrito Fe...	157
Indonesia	683	Kingston, Kingston Pari...	127
United Kingdom	549	Jakarta, Indonesia	108
Mexico	530	New York, NY	96
Brazil	399	Santo Domingo, Santo ...	93
Canada	296	Bangkok, Thailand	80
Taiwan	258	Estado de México, Stat...	72
Philippines	247	Taipei, Taiwan	67
Australia	228	San Diego, CA	62
Malaysia	217	Hong Kong, Hong Kong	61
Jamaica	204	São Paulo, SP, Brazil	51
Germany	171	Lima, Lima Region, Peru	47
France	159	Guatemala City, Guate...	46
Spain	157	London, England, Unit...	46
Thailand	149	Surabaya, East Java, I...	44
Italy	149	Ho Chi Minh City, Vietn...	41
India	148	Las Vegas, NV	41
Costa Rica	146	Rio de Janeiro, RJ, Brazil	40
Dominican Republic	135	Manila, Metro Manila, ...	40
Netherlands	122	Bandung, West Java, I...	39
Puerto Rico	106	Los Angeles, CA	38

A breakdown of the top International Iguana Foundation Facebook page follower numbers by country and city.

## Save Goat Islands 2015

Robin Moore and documentary filmmaker Thaddeus Matula returned to Jamaica last fall to shine a light on the Goat Islands situation once again. The IIF's end of year campaign focused on the Jamaican Iguana and utilized film and photography from Thad and Robin, and also from Scott Trageser, Mario Aldecoa, and Eladio Fernandez. It was well received and far reaching, and brought the issue to the attention of thousands, especially in Jamaica. The video put together by Thad and Robin reached well over 300,000 people and was viewed in various outlets, over 50,000 times. It was shared by reggae artists, Ziggy Marley, The Wailers, and Kabaka Pyramid (who also mentioned the Goat Islands issue in one of his music videos, [Well Done](#), last year). For movie fans, the Incredible Hulk, actor Mark Ruffalo, even shared the film. The Save Goat Islands campaign at the end of last year raised over \$40,000 US dollars. We would like to give special thanks to the following contributors: Jill Jollay, Aaron Zelnik, Kathy Lang, the Association of Zoos and Aquariums' Lizard Advisory Group, and the Detroit Chapter of the American Association of Zoo Keepers!

Keep sending content and promoting Iguana Conservation on social media! We look forward to seeing you all at #ISG2016 in Fiji!

David Hedrick  
Social Media Manager  
International Iguana Foundation  
[d.hedrick@hotmail.com](mailto:d.hedrick@hotmail.com)



*Big Thanks to celebrities such as musicians Kabaka Pyramid (above), Ziggy Marley (below), and actor Mark Ruffalo, who shared the Goat Islands video on Facebook, reaching well over 300,000 people. Photos by Robin Moore.*









A female Jamaican Iguana photographed by Joseph Burgess was featured in a lively music video produced by BBC Earth highlighting endangered species.

Share! <https://youtu.be/OzoCWYNLYLM>

## A New Lease on Life for Endangered “Neon Dragons” of Fiji

Press Release from the IUCN SSC Invasive Species Specialist Group – 15 May 2015

Mataqali Vunaivi of Yanuya Village in the Mamanuca Island group, are welcoming some new residents to their island of Monuriki, about 10 km from Nadi – 32 young Fijian Crested Iguanas, a Critically Endangered species found only in Fiji.

With the agreement of the Mataqali, the National Trust of Fiji and colleagues from the non-government organization BirdLife International, have been restoring the habitat on Monuriki since 2011. They have painstakingly removed all rats and goats. These “invaders” were eating the eggs and hatchlings of the Fijian Crested Iguana and destroying their natural food source. They threatened the species’ very survival. The 32 new arrivals – all bred in captivity at Kula Eco Park and ranging in age from one to three years – will be released as the next step in international efforts to secure a future of this special lizard.

“Fiji is home to several species of unique iguanas, which are found nowhere else in the world,” says Dr. Peter Harlow, the Taronga Zoo ecologist advising the iguana conservation initiative. “They look like neon-colored dragons with their bright green bodies and dorsal crests, but they’re actually perfectly camouflaged to hide in Fiji’s forests. They’re so well hidden that we’re still figuring out which islands have iguanas, and how many species of them there are. So to protect and restore even one tiny island like Monuriki will be a big help and is a credit to the

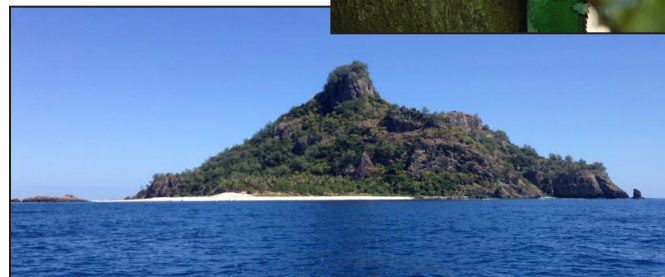
foresight of the traditional landowners – the Mataqali Vunaivi of Yanuya Village.”

“We have been blessed with this restoration project for Monuriki Island as the island is a major source of income not only for my Mataqali, but for the whole village,” states Mr. Maika, spokesman for Mataqali Vunaivi. “This project has also made us realize how important it is to protect the island, for our children’s livelihood in the future and also for this very special iguana, the sea birds, and other plants and animals that live in it. We thank Kula for breeding more iguanas for our island.”

The Fijian Crested Iguana – known to scientists as *Brachylophus vitiensis* – are only known from a few Fijian islands including: Yadua Tabu, Macuata, and Monuriki, and nowhere else on Earth. The land area of Monuriki is only 40 hectares, and yet somehow, it is home to Crested Iguanas—whose ancestral origins are still a mystery to scientists.

“Their closest iguana relatives apart from the other Fijian iguanas are more than 8,000 kilometers away in the Galápagos and southwestern North America, and their genetics suggests an even more confusing ancestry,” says Dr. Robert Fisher, U.S. Geological Survey, who is based in California but has studied Fijian natural history for 25 years. “It’s another reason why Fiji’s native wildlife and habitats are important to science, and important for the local community to protect for future study and appreciation.”

Hatched and raised at Kula Eco Park at Korotogo to an age and length sufficient to increase their odds of surviving predators, this is the first time that Fijian Crested Iguanas (and the first Fiji endangered species ever) have been bred in captivity and then introduced into the wild. Now, Australian, U.S., and Fijian scientists will track the survival of these



Monuriki Island - ideal forest habitat rehabilitated for Fijian Crested Iguanas. Photographs by Nick Felstead.





*Each young iguana has a microchip implanted under its skin for permanent identification (left). Ramesh Chand from Kula Eco Park supervises an iguana release by Yanuya school children (above). Photograph by Nick Felstead.*

32 young lizards, which each have a unique microchip inserted to identify them when they are recaptured, so that their growth and health can be recorded and compared.

"It's a proud moment for us all," said Ramesh Chand, Director and Manager of the breeding program at Kula Eco Park, "By allowing us to remove a few of the remaining iguanas and breed new stock from them, the traditional landowners have potentially saved a piece of Fiji's natural heritage from extinction, and we are delighted with the results achieved."

But the removal of the "invaders" is already having benefits beyond iguanas. Recovery of the unique dry forest can be seen in the emergence of many young native trees and shrubs which provide essential food and shelter for the iguana and other wildlife. Birds, such as the Banded Rail previously unrecorded for the island are now being observed, and nesting seabirds like the Wedge-tailed Shearwater are breeding successfully and the colony is expected to increase over time.

While all rats and goats have been successfully eliminated from Monuriki (and nearby Kadomo), a sizeable challenge remains in ensuring these predators and all other non-native species including mongoose, cats, dogs, and pigs among many others are never introduced to the island. NatureFiji-MareqetiViti and the National Trust, together with the landowners, communities, and tourism operators of the area, are putting in place controls that will prevent these reintroductions. "However, for this to be successful it will require the support of everyone visiting the island to check their equipment and boats in ensuring there are no rats and other introduced species that could be accidentally introduced. If

we all do this, together we will leave a very special and unique legacy for Fiji's future generations" says Sia Rasalato of BirdLife International.

"It has taken years of preparation and work to get rid of these two invasive species; however a careless visitor to Monuriki Island could bring them back in a day, so we asking if visitors could assist us in implementing biosecurity checks before they visit Monuriki and to be very careful" concluded Mr. Maika. He has urged tour operators, stakeholders, fishermen, and others who may visit the island to check their boats and equipment for possible stowaways.

Part of the funding for the captive breeding program at Kula Eco Park came from the Critical Ecosystem Partnership Fund. Since mid-2012, the program has been fully funded by Kula Eco Park, while the iguana reintroduction program has received support from San Diego Zoo in California. The removal of introduced predators was led by BirdLife International, in partnership with the National Trust, Monuriki landowners and Yanuya community, the David & Lucile Packard Foundation, and the Critical Ecosystem Partnership Fund. Many other individuals, and national and international organizations, have and continue to contribute to this restoration effort including NatureFiji-MareqetiViti, Fiji government agencies, the Pacific Invasives Initiative, Taronga Zoo, San Diego Zoo, Los Angeles Zoo, Durrell Conservation Academy, and International Iguana Foundation, in what is an exemplary partnership with the customary owners of Monuriki Island.



## Iguana captive breeding program in Fiji posts first positive results

**A group of endangered iguanas introduced to the Fijian island of Monuriki two months ago have been tracked down and appear to be healthy**

Reprinted from The Guardian  
14 July 2015, by Monica Tan

Scientists have welcomed the first results of a captive breeding program aimed at saving a group of Critically Endangered Fijian Crested Iguanas, the first such attempt to reintroduce a species in that country.

Some of the iguanas that were introduced to the Fijian island of Monuriki two months ago have been tracked down by scientists and appear to be healthy. A total of 32 iguanas were microchipped and released, with tiny radio transmitters glued to the tails of 11 for tracking purposes. Nine were recovered on Sunday.

US Geological Survey biologist Robert Fisher reported all had increased in length and lost their excessive weight. A lean diet of native plants had evidently “sorted them out,” he said. There was no evidence of trauma or other health issues.

This is the first time Fiji has bred an endangered species in captivity and introduced it into the wild, with the National Trust for Fiji implementing a 2010 International Union for Conservation of Nature (IUCN) species recovery plan.

Fijian Crested Iguanas are endemic to only a handful of islands. Peter Harlow, an ecologist at Sydney’s Taronga zoo and member of the program’s steering committee, said the islands had never been connected to a continental land mass, and were formed through volcanic eruptions millions of years ago. The iguanas’ closest relatives live more than 8,000 km away in the Galápagos Islands and south-western North America, making their ancestry “one of the great mysteries”



*Nature-Fiji developed an educational display at the Yanuya Community Hall. Photograph by Nick Felstead.*

of ecology, he said. “The only possible way [the iguanas] could have reached there was by rafting or floating across the Pacific [Ocean].”

While about 12,000 iguanas live on the protected sanctuary island of Yadua Tabu, numbers on neighbouring Monuriki have been in rapid decline. They feed on the island’s native plants, which were severely degraded by forest burning and the introduction of goats in the 1960s by the traditional owners, the Mataqali Vunaivi.

The iguanas had a brush with conservationist fame in 1994, when Steve and Terri Irwin visited Monuriki and Tokoriki to search for the elusive population. During a 12-day stay they encountered only three caged individuals. Harlow first surveyed the iguanas in 1998 and found fewer than 80 individuals and no juveniles. In 2010 a recovery plan was finally implemented, with 21 iguanas captured and removed over a two-year period by the National Trust of Fiji and taken to the captive breeding facilities at Kula Eco Park.

Eight males and nine females successfully reproduced at the park. At the same time, the Mataqali Vunaivi people began eradicating the goats from the island. Restoration work has led to the recovery of the island’s unique dry forest.

Iguanas play a villainous role in local Fijian mythology, but shifting cultural attitudes have led to a new commitment to conservation. A spokesman for the Mataqali Vunaivi people, Ratu Maika Ratu, called the program a blessing.

“This project has made us realise how important it is to protect the island, for our children’s livelihood in the future and also for this very special iguana, the sea birds and other plants and animals that live in it,” he said.

Fijian Crested Iguanas are a vivid green, but have the ability to change colour and become very difficult to spot when living in treetops. They grow to about 75 cm from nose to tail tip, and have strong legs and sharp claws, making them excellent climbers. They are also herbivores, eating leaves, fruits, shoots and flowers, and are “vital seed distributors”, Harlow said, digesting plants such as the Pacific Hibiscus and Tahitian Chestnut, and spreading their seeds across the island.

New and rejuvenated populations of birdlife such as the buff-banded rail and the wedgetailed shearwater have also been spotted on the island thanks to rejuvenation of the forests.

The director and manager of the breeding program at Kula Eco Park, Ramesh Chand, called it a “proud moment”.

“By allowing us to remove a few of the remaining iguanas and breed new stock from them, the traditional landowners have potentially saved a piece of Fiji’s natural heritage from extinction.”



## Taxon Reports

### Oaxacan Spiny-tailed Iguana (*Ctenosaura oaxacana*)

#### The Effects of Habitat Fragmentation and Hunting on the Genetic Diversity of the Threatened Oaxacan Spiny-tailed Iguana.

IIF Grant Report submitted by Gabriela Díaz-Juárez and Víctor Hugo Reynoso, Instituto de Biología, Universidad Nacional Autónoma de México (UNAM). *Photos by Gabriela Díaz-Juárez unless otherwise noted.*

Support was requested from the IIF to cover fieldwork expenses for the project: "Effects of habitat fragmentation and hunting on the genetic diversity of endangered Oaxacan Spiny-tailed Iguanas." This report summarizes our February and April-May 2015 survey periods. We captured 370 iguanas from 24 localities, from Puerto Escondido to the border of Chiapas, in the Isthmus of Tehuantepec, Oaxaca. We obtained 30 samples from nine sites where *Ctenosaura oaxacana* suffers either habitat fragmentation and/or hunting, and 10 samples from 10 localities throughout the distributional range of the species to understand its overall genetic variability. During this survey, we also obtained basic natural history parameters of the species throughout its range, photographed 370 iguanas to document morphological variation, evaluated the habitat and microhabitat where iguanas were found, conducted an evaluation of local people's perception towards the conservation of the iguana, and verified presence of iguanas in areas where they were reported previously. Sampling for genetic studies was, however, the main aim of the project overall. Molecular data is needed to establish the effect of habitat fragmentation and hunting on the overall genetic diversity and structure of the species, and to establish the effective population size of all populations and the species' population trends. The results from this project will provide information to create management plans and/or conservation strategies to preserve the Oaxacan Spiny-tailed Iguana.

**Introduction.** The constant increase in human activities such as changing land use for logging, agriculture, livestock, and urbanization have led to an increase in habitat fragmentation, causing a heterogeneous distribution of populations. Fragmentation of iguana populations

will produce numerous habitat patches smaller than the original continuous forest, forcing the animals to move, and in the short term to reduce their populations (Gerber and Templeton, 1996). Habitat fragmentation also creates barriers that isolate populations (Hitchings and Beebee 1997; Gerlach and Musolf, 2000). Fragmentation and loss of habitat combined with extensive hunting are serious problems facing most *Ctenosaura* populations. Habitat fragmentation and hunting has increased with human population growth and unemployment. Despite protection by Mexican law NOM 059 (SEMARNAT, 2010), iguanas are considered for traditional use and hunting by native people is tolerated. It is known that iguanas are more vulnerable during nesting season because both females and eggs are removed from the system, thus, preventing the recruitment of new individuals.



The Oaxacan Spiny-tailed iguana, *C. oaxacana*, is endemic to the Mexican state of Oaxaca and restricted to very small areas (526 km<sup>2</sup>) of tropical dry forest in the lowlands of southeastern Oaxaca. The IUCN Red List of Threatened Species assesses it as Critically Endangered, with a decreasing population trend, and being one of the most vulnerable species of *Ctenosaura* (Köhler, 2004). Their populations have suffered significant reductions due to hunting and land use change for agriculture, livestock, and logging that has changed their natural environment (Rioja et al., 2012). A recent study about demography and life history revealed that populations not hunted in conserved forest areas remain stable (Díaz-Juárez, 2014), but to date the conservation status of populations in areas with a high degree

of habitat fragmentation and intensive hunting is unknown. Martinez (2015) showed very low genetic variation in a very small fragment with these iguanas. The only published study on the ecology of this species was about habitat preference (Rioja et al., 2012), and Díaz-Juárez and Reynoso (submitted) now provide a detailed and comprehensive analysis of the life history traits and demography of the species.

This study of the structure and genetic diversity of populations of the Oaxacan Spiny-tailed Iguana, combining mitochondrial DNA, nuclear DNA, and microsatellite markers, will provide a short cut to understanding the conservation status of the iguana throughout its distribution and is an alternative to extensive monitoring. These methods are especially useful for species with large populations or that live in complicated areas (e.g., topography) where detailed monitoring is impossible. At the end of this study we aim to achieve two main goals: a) determine the genetic diversity and structure of the species as a whole and establish the effect of habitat fragmentation and hunting; and b) establish the effective population size of every population, and its predicted population trend for the future.

#### METHODS and RESULTS

**Habitat and Microhabitat.** We searched for Spiny-tailed Iguanas, *C. oaxacana*, within tree hollows along its entire distribution in the tropical dry forest along the southern coast of Oaxaca and the Tehuantepec Isthmus, in southern México. From February 2nd to 26th, 2015, nine populations were selected in the Tehuantepec Isthmus: three sites with continuous forest where iguanas are not hunted, three sites with continuous forest and high hunting rate, and three fragmented areas where iguanas are not hunted. We searched each site for 2-3 days. In each site we evaluated environmental factors, topography, and vegetation.

From April 11th to May 15th, we sampled 15 randomly-selected sites throughout the southern coast of Oaxaca and the Isthmus of Tehuantepec to understand the morphological and genetic geographic variation of the species. During this second survey we also recorded the species of tree where iguanas were captured, the diameter of the cavity occupied by the iguana and associated tree diameter, ambient temperature and humidity, and the temperature inside the hole.

Oaxacan Spiny-tailed Iguanas were captured only in tree species that produce holes, such as: *Lysiloma microphyllum*, *Genipa americana*, *Byrsonima crassifolia*, *Mimosa eurycarpa*, *M.*

Microhabitat Preference	Tree: Common Name	Species
14.5	Zarza	<i>Mimosa sp.</i>
9.09	Grisiña	<i>Cordia elaeagnoides</i>
3.63	Palo de Arco	<i>Acacia coulteri</i>
3.63	Brasil	<i>Haematoxylum brasiletto</i>
7.27	Palo de Gumaga	<i>Havardia campylacantha</i>
5.45	Tepeguaje	<i>Lysiloma microphyllum</i>
3.63	Morro	<i>Crescentia alata</i>
3.63	Nanche	<i>Byrsonima crassifolia</i>
20	Tepezcohuite	<i>Mimosa tenuiflora</i>
16.36	Titatil	<i>Comocladia engleriana</i>

Table 1. Percentages of tree preference inhabited by the Oaxacan Spiny-tailed Iguana.

*tenuiflora*, *Acacia coulteri*, *Cordia elaeagnoides*, *Comocladia engleriana*, *Crescentia alata*, *C. cujete*, *Haematoxylum brasiletto*, and *Havardia campylacantha* (Table 1). The hollows that iguanas inhabited ranged from 4 to 80 cm diameter (average  $34.32 \pm 14.78$  cm). Tree diameter ranged from 12 to 250 cm (average  $130.9 \pm 44.71$  cm). Ambient temperature ranged from 24 to 40° C (average  $36.67 \pm 2.08$ ° C) while the temperature in the refuge ranged from 24 to 36° C (average  $35.09 \pm 1.68$ ° C). Ambient humidity ranged from 47 to 75% (average  $57.17 \pm 10.96$ % RH).

**Morphological Data.** We recorded snout-vent length (SVL), head length (HL), head width (HW), tail length (T), tibia length (Tib), mass, and sex. We generated a high-quality photographic record of each iguana with full body pictures (dorsal, lateral, and ventral views) to understand geographical variation and to produce a morphological variation catalogue for the species.

We captured 370 iguanas from two field sampling sessions, where 34% were females, 43% males, 13% juveniles (sexually immature individuals), and 10% hatchlings. Morphometrics are



Collecting morphometric data in the field. Photo by Adrian Guerra Galvan.

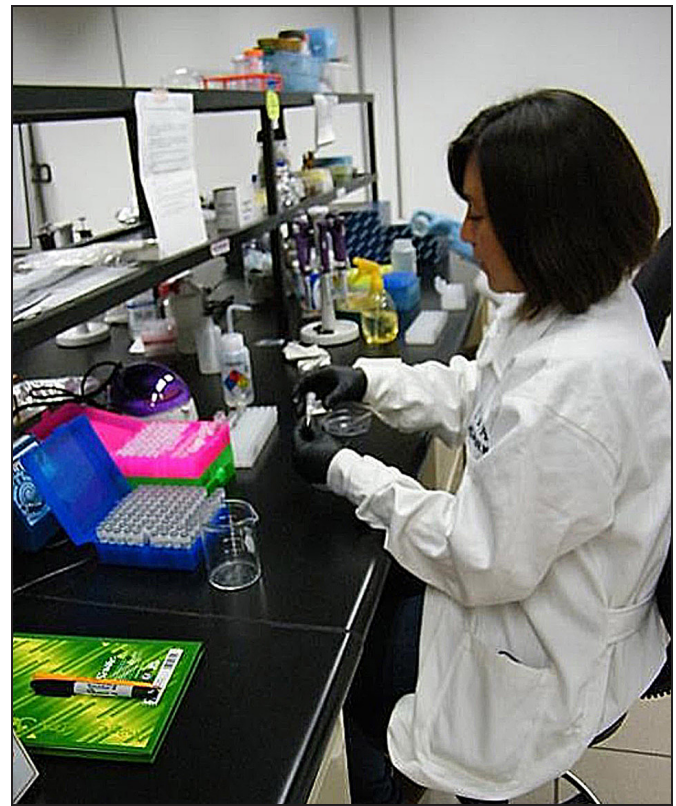


	Sex	N	Mean	Minimum	Maximum	S.D.
SVL (cm)	Female	127	12.7	12.0	13.5	0.58
	Male	160	14.9	13.5	18.0	1.06
	Juvenile	47	11.2	10.5	11.8	0.05
	Hatchling	36	8.7	4.0	10.0	0.18
Mass (g)	Female	127	67.5	26.0	108.0	16.90
	Male	160	114.6	60.0	200.0	27.50
	Juvenile	47	47.5	26.0	64.0	1.05
	Hatchling	36	26.1	10.0	42.0	1.29
HL (mm)	Female	127	25.8	17.2	32.3	2.91
	Male	160	29.6	19.2	38.3	3.42
	Juvenile	47	21.3	12.1	25.8	2.42
	Hatchling	36	18.2	11.9	24.2	2.06
HW (mm)	Female	127	17.7	13.7	23.3	2.20
	Male	160	21.4	14.3	29.1	2.81
	Juvenile	47	14.5	11.6	17.9	1.67
	Hatchling	36	11.4	7.9	13.1	1.50
Tib (mm)	Female	127	22.6	17.5	29.4	2.72
	Male	160	26.3	16.1	33.2	3.37
	Juvenile	47	17.7	13.3	23.9	2.57
	Hatchling	36	13.2	8.0	17.0	2.98



Table 2. Morphometric measurements recorded for *C. oaxacana*. Snout-vent length (SVL), head length (HL), head width (HW), tail length (T), tibia length (Tib).

Laboratory analysis of blood samples for genetic markers (right). Photo by Canek Rivera Arroyo.



summarized in Table 2. Morphometric information recorded in this randomly sampled survey will be useful to understand the demography of the species and to establish morphometric relationships with other species of *Ctenosaura*.

**Community Interviews.** We interviewed 100 people along the coast of Oaxaca and the Tehuantepec Isthmus to gather information about the use and practices towards iguanas within their communities, and to evaluate people's perception towards the benefit of protecting the Oaxacan Spiny-tailed Iguana. The interview was conducted through an open discussion based on a questionnaire that was intended to make people feel comfortable.

Based on these conversations, we can establish that generically "iguanas" have been an important part of the culture and development of Mexican society as the subjects of consumption and trade. However, the increase of human activities and loss of habitat has altered the populations of iguanas and many other wild species.

The people we spoke to asserted that hunting iguanas increases during the egg-laying season (February-March). However, catches are also made occasionally throughout the year, mainly by people working in the fields and by those that survey trees or fences that divide land

ownership. Iguanas are captured primarily for meat consumption, because it is a free available resource and is mostly very tasty. However, there are people who capture them to sell their meat, as pets, or just for fun. In regions with some degree of urban development, people have stopped working in fields, so hunting iguanas has become an occasional activity. Moreover, they know that iguanas are prohibited for trade and that their populations have decreased by the action of hunting, habitat destruction, and the introduction of exotic species (cattle, poultry, dogs, and cats). Unfortunately, they believe that iguanas are used as a resource due to lack of government support for agriculture, fisheries, and the lack of paying jobs. People living in interviewed communities expressed willingness to participate in conservation, together with government and private institutions as long as their rights and their natural, social, and economic resources are respected, and that they are provided with short-term results to benefit their communities.

In the absence of sufficient information about the use and conservation of iguanas, it is essential to establish educational programs to raise awareness on the conservation and sustainable use of species that are in some category of protection, and especially for the iguanas.

**Genetics Laboratory Work.** From each captured iguana, we withdrew 0.5 ml of blood from the caudal vein and preserved it in 96% alcohol. DNA

was extracted using the salt extraction method of Aljanabí and Martínez (1997). The DNA concentration and quality were observed 1% agarose gels stained with red-gel (1 µl/ml) and run on 0.5X TAE buffer using a molecular weight marker of 100 bp. We successfully conducted PCR reactions on five fluorescent microsatellite markers (Pec-01, Pec-03, Pec-16, Pec-20, and Pec-25) with a final concentration of 15 µl and collected allelic data for all populations. The final concentrations of the reaction were: 1µl of DNA; 0.2 µl of Taq polymerase (5µ/µl); 1.5µl of PCR buffer; 0.6 mM dNTP (10 mM), 0.6 µl of each primer, and 0.9 µl of MgCl<sub>2</sub>. The PCR products were visualized on 2% agarose gels stained with red-gel (1 µl/ml) run in 0.5X TAE buffer using a molecular weight marker of 100 bp. Genetic analysis with four markers for mitochondrial and nuclear DNA is still preliminary.

### DISCUSSION

Populations of Oaxacan Spiny-tailed Iguanas are mostly in small fragments or patches as a result of human activities. Vegetation structure indicates that generally this iguana is mainly distributed in dry forests throughout its range as reported by Rioja et al. (2012) and in Nizanda by Díaz-Juárez and Reynoso (submitted). *Ctenosaura oaxacana* prefers trees with small holes in proportion to their body size, where they can fit tightly. The distribution of iguanas is limited to the presence of tree species with holes, but can also live in fences made with this same kind of tree. Díaz-Juárez (2014) observed that the trees mainly used as refuges are *Mimosa eurycarpa* (Gui'chi bateede, 93%), *Mimosa tenuiflora* (Gui'chi bu, 4%), and only occasionally (1.1%) iguanas were captured in the trunk of *Chloroleucon manguense* (Gui'chi dxita) and *Caesalpinia platyloba* (Tepeguaje). In our fieldwork, we observed that the topographical composition changes between

each locality in the Isthmus of Tehuantepec and the coasts of Oaxaca. These areas are dominated by tropical deciduous and semi-deciduous forests. We identified new species of trees that are used as shelters by Oaxacan Spiny-tailed Iguana: *Lysiloma microphyllum*, *Genipa americana*, *Byrsonima crassifolia*, *Acacia coulteri*, *Cordia elaeagnoides*, *Comocladia engleriana*, *Crescentia alata*, *C. cujete*, *Haematoxylum brasiletto*, and *Havardia campylacantha*. Unfortunately, habitat loss and land use change for agriculture or livestock is a common aspect of the landscape throughout the entire distribution of this iguana.

Morphometric data indicate that the average length of females and males ( $12.6 \pm 1.15$  cm), coincide well with those reported by Díaz-Juárez and Reynoso (submitted), as well as for body mass ( $67.6 \pm 21.02$  g). Topographic composition also appears to influence dispersal, morphology, and perhaps social structure. Morphometric data revealed that populations in the Isthmus of Tehuantepec have similar proportions to those reported by Díaz-Juárez and Reynoso (submitted), except in La Venta where the largest iguanas were captured at 18 cm SVL and 200 g body mass. Along the coast of Oaxaca, the smallest sizes were found in the northern coast with a maximum length of 16.5 cm and weight of 145 g. Contrasting, the southern coast of Oaxaca reported the larger sizes of 17 cm SVL and 180 g body mass.

Body color of Oaxacan Spiny-tailed Iguana changes slightly throughout its distribution, mainly in males. Iguanas along the Oaxacan coast were observed with small white spots on the back and pigmentation from yellow to orange on the belly. In contrast, in the Isthmus Tehuantepec they have small white dots and dark bands and the ventral region is beige.

Overall, we observed that the sex ratio does not differ from an even 1:1 ( $\chi^2 = 14.7$ ,  $P = 0.54$ ) and compares to that estimated by Díaz-Juárez and Reynoso (submitted) in Nizanda. We observed that this species increases its vagility during the egg-laying season (February-March), hatching season (June-August), and breeding season (December-January). However, hunting and fragmentation also might be influencing these results (Díaz-Juárez and Reynoso, submitted).

The Isthmus of Tehuantepec and the coast of Oaxaca have marked fragmentation, which has caused a considerable reduction among the iguana populations. According to the commentaries of people, it is becoming less common to find these iguanas in the fields, and even some young people are unaware this species exists.

People believed that legislation or season closures on the use of ctenosaurs and other wildlife species should be established. In some



Presentations on iguana conservation were held for local communities. Photo by Ricardo Colin.



localities, people are willing to organize and work to ensure that there is no looting and misuse of Oaxacan Spiny-tailed Iguana, and some want to build small iguana programs where they can establish a method of partial-incubation of eggs with the aim to increase recruitment of individuals to populations.

Survival for the Oaxaca Spiny-tailed Iguana is possibly related to protecting the microhabitat that contains trees preferred as refuges. Therefore, it is important to expand the ecological and demographic studies at sites that were sampled to determine the temporal and environmental variability characterizing this species, and provide basic information such as population density, life history, home range, population structure, and behavior.

### CONCLUSIONS

Knowledge of the natural history of the Oaxaca Spiny-tailed Iguana is essential to provide information to people and create awareness about the conservation of wild populations of *C. oaxacana* and other iguana species, habitat conservation, and their sustainable use. Here we show that with a relatively small number of individuals captured along the distribution range of a species with a complex distribution pattern, it is possible to obtain a great variety of relevant information at a low cost and in a short time frame. Information on aspects of habitat, environment, natural history, morphometry, and demography were obtained. Furthermore, information generated from the genetic analysis will determine the viability and genetic variation of populations. Therefore, it is advisable to carry out such studies with species that are in some category of risk, are economically important, or endemic, such as the Oaxacan Spiny-tailed Iguana.

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## Roatán Spiny-tailed Iguana (*Ctenosaura oedirhina*)

### 2015 Roatán Spiny-tailed Iguana End of Year Project Report.

IIF Grant Report submitted by Ashley Campbell, Florida Atlantic University, USA.

The Roatán Spiny-tailed Iguana (*Ctenosaura oedirhina*) is listed as Endangered by the IUCN and as threatened by the Honduran government. This endemic species is found in high densities within pockets of protected habitat on Roatán. The protection offered in these areas is at the grassroots level and is very unstable; there is no enforced protection by local authorities. Outside of the protected areas, the iguanas are illegally harvested and found only in very low densities, if at all. The small, high-density areas are critical for the survival of this species on the island. Aside from hunting, these iguanas are threatened with habitat loss and fragmentation, predation from domestic species, and the potential encroachment of a related, invasive ctenosaur, *C. similis*.

This study continued to build on the past five years of research, began by Pasachnik and continued by Campbell. The objectives for 2015 were to continue the morphometric and demographic mark-recapture survey and to begin health and fitness evaluations from iguanas found in study sites. In future years we hope to continue with this demographic work through training workshops, transforming this project into a long-term study of population dynamics in ctenosaur iguanas and a progressive education program.

As in previous years, life history and morphometric data were collected. In 2015, one hundred new individuals were captured and tagged and 21 individuals were recaptured. Now 869 individuals have been tagged (~20% of the entire population). Analysis of all mark-recapture data indicated a very high adult mortality (potentially up to 80%) and analysis of distance sampling data indicate that densities have decreased over the course of this five year study. The total population on the island is estimated at 4,130-4,860 iguanas. A population viability analysis shows the population declining towards extinction within the next decade and sensitivity analysis suggests that female mortality is a main factor in the decline.

As part of the new objectives this year, fifty flight distance surveys were conducted at three of the main study locations. Two of the locations could not be surveyed in this aspect because of steep cliffs and thick underbrush. Flight distance may indicate both habituation to

human disturbance and increased predation risk (mostly from humans, in this case). Habituation to human disturbance could affect health, as seen in Hines (2011), where habituated iguanas were fed unnatural foods. A decrease in flight distance could also affect predation attempts making the species increasingly vulnerable to humans and other predators.

In 2013, ectoparasites (ticks and mites) were surveyed on all captured iguanas via handheld magnifier and forceps. Preliminary analysis of this data shows that there is a difference in ectoparasite load between study locations. To better understand this difference, this protocol was continued in 2015. Endoparasites had not previously been systematically surveyed in this species and were only known from post mortem examination of car strike carcasses. Fecal samples were collected opportunistically from the ground or from the holding bags iguanas are placed in immediately after capture. They were analyzed for eggs, cysts, larva, and adult parasites using the standard veterinary techniques of floatation and smear slides. Blood samples were taken from the caudal vein and used to prepare a blood smear, which was analyzed under oil immersion for eggs, larvae, and adult parasites. Fifty fecal samples and 80 blood samples were analyzed. Fecal samples from Common Green Iguana (*Iguana iguana*) were also analyzed for comparison, as they are broadly sympatric with *C. oedirhina*. The *C. oedirhina* samples were generally free of internal parasites, with only two found with pinworm egg cases in the fecal



#780 was newly captured in spring 2015. Recaptured individuals such as #575, give important information about the iguanas, including growth and mortality data.



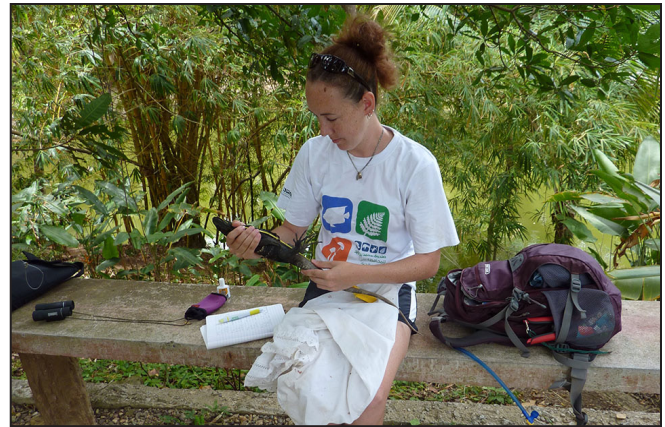


float samples and three with microfilaria in the blood smears. The *I. iguana* fecal samples however were heavily infested with pinworm and flukes. The occurrence of external parasites on *C. oedirhina* appears to be related to substrate at the locations. Both flight distance and health data will be analyzed and summarized in a manuscript to be submitted in the summer of 2016.

This year, management at one of the study locations changed. Previously, we had relatively unrestricted access to this park during daylight hours, however this year we were unable to gain entrance on days when the park was closed to tourists (sometimes up to 5 days a week). This impacted the study because we could only reliably gain access when the park was full of tourists and some of the trails were being used for 4x4 off-road vehicles, making surveys dangerous and generally unproductive. We were unable to make contact with the new manager after multiple attempts, phone calls, and emails. While the estimated density at this location is similar to last year's, we do not know if this population is still being protected the way it was before, making it potentially vulnerable. We will continue to reach out to this organization in hopes of once again gaining access but more importantly in hopes of ensuring that this population is still protected. This situation demonstrates the vulnerability of this species as all stable populations of *C. oedirhina* are in privately owned areas that are protected by grassroots efforts and thus with a change in management the level of protection afforded at a given site can quickly change.

#### Milestones for 2015

- "Habitat utilization of Roatán Spiny-tailed Iguanas (*Ctenosaura oedirhina*) and Its implications for conservation" was accepted for publication in the Iguanas of the World volume of Herpetology Conservation and Biology.
- "Population genetics of Roatán Spiny-tailed Iguanas, *Ctenosaura oedirhina*" was accepted

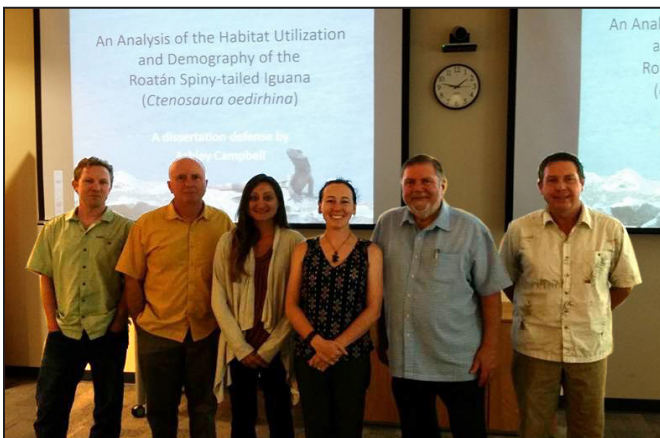


Ashley Campbell measuring the snout-to-vent length (SVL) of a Roatán Spiny-tailed Iguana.

- for publication in the Iguanas of the World volume of Herpetology Conservation and Biology.
- "Piebaldism in Roatán Spiny-tailed Iguanas, *Ctenosaura oedirhina*" was submitted to the Journal of Herpetology for review.
- Fifty fecal samples and 80 blood samples were analyzed.
- One hundred new iguanas were captured and 21 were recaptured.
- Adult mortality was estimated at 81% for one of the locations using Program Mark. The mortality at the other four locations could not be reliably estimated because of lack of resightings.
- Iguana densities estimated from distance sampling at the study locations have declined 36% since 2012.
- The data show the high-density populations have been decreasing since the beginning of the study. The current population size is estimated to be 4130-4860 individuals as of 2015.
- "An analysis of habitat usage and demography of the Roatán Spiny-tailed Iguana (*Ctenosaura oedirhina*)" Ph.D. dissertation by Campbell was written and will be defended on October 26, 2015.

Additional manuscripts will be submitted:

- 1) "Demography of the Roatán Spiny-tailed Iguana (*Ctenosaura oedirhina*)" - to be submitted spring of 2016.
- 2) "Population Viability Analysis of the Roatán Spiny-tailed Iguana (*Ctenosaura oedirhina*)" - to be submitted summer 2016.
- 3) "Conservation of an Endemic Iguana in Honduras" - to be submitted summer 2016.
- 4) "Anthropogenic Influences on Health in *Ctenosaura oedirhina* Populations" - to be submitted fall 2016.
- 5) All data gathered and analyzed thus far will be used to complete a IUCN Red List update during the 2015 annual ISG meeting.



Ashley Campbell and thesis committee during her Ph.D. dissertation defense on October 26, 2015.





This *Ctenosaura oedirhina* is basking outside of its refuge on a rock face at one of our study areas.

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Hines, K.N. 2011. Effects of Ecotourism on Endangered Northern Bahamian Rock Iguanas (*Cyclura cychlura*). *Herpetological Conservation and Biology* 6(2):250-259.



## Hispaniolan Rhinoceros Iguana (*Cyclura cornuta*)

### Husbandry and Education Capacity Building to Support *Cyclura* Conservation in the Dominican Republic.

IIF Grant Report submitted by Rosanna Carreras De León, Instituto Tecnológico de Santo Domingo Dominican Republic, and Stesha A. Pasachnik, San Diego Zoo Institute for Conservation Research, USA. Photos by Rosanna Carreras De León unless otherwise noted.

Local conservation efforts for Hispaniolan iguanas have increased in the last decade, with the efforts of San Diego Zoo, IIF, INTEC University and primarily the Dominican NGO Grupo Jaragua. However, the majority of these efforts has focused on *Cyclura ricordii* and has neglected *Cyclura cornuta*, though both species are endemic to the island and are threatened.

Although *Cyclura ricordii* is listed as Critically Endangered and *Cyclura cornuta* as Vulnerable, recent evidence suggests *C. cornuta* is declining at alarming rates, due to exploitation for food and the pet trade, and habitat destruction for charcoal production, farming, and development. We thus began a variety of projects focusing on the ecology and genetics of *C. cornuta* in 2012. Specifically, studies concerning population genetic structure, range distribution and current threats, nesting ecology, and hatchling dispersal are underway. During our investigations it became clear that captive breeding facilities, called iguanarios, posed an additional threat to the species. There is no attention given to the origin of these individuals as they are moved from place to place. Individuals are being relocated throughout the country without considering proper management and husbandry, or genetics.

Our preliminary genetic results for *C. cornuta* suggest that there are multiple haplotypes distributed across the country and that the majority of iguanas in captivity are not from their respective area but are mostly from a popular hunting location in the southwest. The majority of iguanarios occur in the southeast. The genetic consequences of potential hybridization between populations of *C. cornuta* from extreme sides of the Dominican Republic, as well as the haphazard release of offspring and at times adults without any follow up and organization, could be detrimental. In addition, the need to eradicate the now widely distributed invasive Common Green Iguana makes conservation efforts for the native iguanas confusing to local communities, though it is immensely important to the native iguanas and other native flora and fauna. Last year, we began a movement to bring these iguanarios together and build capacity through education and outreach, such that these facilities may serve as education and conservation centers.



Adult male Rhinoceros Iguana at Manati Park, one of the largest of DR's iguanarios. Here iguanas reproduce successfully, however this iguanario is overcrowded and iguanas constantly escape and breed in the surroundings. This is supported by the Park managers.



Education is vital to achieving proper management of this species. Our first workshop aimed at addressing the various husbandry, ecological, and genetic hazards posed by the iguanarios was held in 2014 and was a huge success. To continue addressing these issues we conducted site visits of all the known iguanarios and held a second workshop in Punta Cana Ecological Reserve located in the Higüey province, from June 17 to 20, 2015. Our site visits focused on assessing the improvements made and continued issues facing the iguanarios. The workshop focused on: 1) promoting the best available iguana husbandry and management practices among the staff and administrators of the different iguanarios; and 2) collaborating with educators to improve the content of the educational materials.



Outback Adventure Park, Higüey; iguanas are doing well after implementing husbandry recommendations (above). Invitation to the 2015 Workshop, with Scape Park iguanas in background which are very healthy (below).



**Accomplishments.** We conducted site visits of each iguanario during the spring of 2015 in order to follow up with the objectives and directions given in the 2014 workshop (see details below). We evaluated each facility to determine if improvements were made in basic husbandry techniques and gathered information regarding what issues are continuing and how we can aid these facilities in the future.

We had previously collected DNA samples from all known iguanarios. This year we discovered a new facility located in Rancho Outback Adventure in Anamuyá, Higüey, and collected DNA from all their individuals. We also marked each individual with bead and PIT tags in order to identify the individuals.

We held a second workshop in June 2015 (see details below). Given that this was a follow-up workshop, we provided a more detailed level of information and focused on more specific needs for each facility (concentrating on ideas gathered through our site visits). We continued to reinforce many of the same ideas and methods, with hands-on training. We invited a guest speaker, Miguel Garcia, to discuss what it takes to have a proper captive breeding facility for conservation.

We had each iguanario complete a self- and group-evaluation of their facilities and each other's facilities, encouraging team-work and advancement of each person's expertise. We re-enforced the potential impact that Common Green Iguanas (*Iguana iguana*) may have in the Dominican Republic with an invited speaker Ricardo Lopez Ortiz, from Puerto Rico.

**Site Visits.** Each iguanario visited was evaluated based on their improvements and/or changes in the following areas: iguana nutrition, facility improvements, quarantine, manipulation, medical attention, record keeping, reproductive control, accidental and/or intended release, education and eco-touristic initiatives. The overall impressions from the given criteria are as follows:

- 1) The iguanarios made significant positive changes in nutrition for their iguanas, including removing dog food and lettuce and incorporating some of the recommended vegetables.
- 2) Facilities did not face complicated medical emergencies in the year since the first workshop.
- 3) Some of these facilities have a high eco-tourism value; the revenue from which they depend on.
- 4) Reproductive control remains a great problem in the two biggest iguanarios, Manatí Park and Cuevas de las Maravillas, where thousands of iguanas are kept in captivity. Drastic measures need to be taken in these facilities if they are to be able to maintain proper care and reduce the threat they are posing to the wild populations in their respective areas. We recommend that the Ministry of the Environment get involved in managing these situations. The smaller iguanarios seem to be managing reproductive control, though they need to continue to stay on top of these measures. The iguanario Los Tocones in Samaná, was able to completely stop reproduction in their facility due to the relocation of the iguanas.





Rosanna Carreras De León and Stesha Pasachnik explain handling and sampling techniques during the Workshop. Photograph by Víctor Vélez (left). A site visit to the iguanario from Outback Adventures during the workshop - viewing the quarantine area where babies are separated from the adults.



5) Smaller iguanarios in the north of the country, Rudy's and Jungle Tours, which maintain iguanas for exhibition, including the invasive Green Iguana, still present very poor conditions for the animals.

6) A serious problem remaining for all iguanarios is record keeping. The majority of facilities do not keep any records of each individual, breeding events, releases, injuries, growth, etc.

7) Accidental escapes and intended liberations continue to occur, particularly in the larger facilities. This is a topic that will require continued education efforts concerning genetics, outbreeding depression, and local adaptation.

8) Invasive Green Iguanas are being kept, and even with the intention to breed in at least one case (Manatí Park), though it is illegal to do so in the country. Again, it is recommended that the government take action in this case.

**Workshop 2015.** With the collaboration of the Punta Cana Ecological Reserve and Grupo Jaragua, 13 institutions directly related to iguanarios in the Dominican Republic participated in the second workshop, for a total of 24 participants between managers and educators. Participants attended from the following organizations: Acuario Nacional, Cap Cana Escape Park, Cuevas de las Maravillas, Grupo Jaragua, Los Tocones (Samaná), Rancho Outback Adventure (Anamuyá), Reserva Ecológica Punta Cana, SEAVIS Tour (Tanamá Bayahibe), Sociedad Ornitológica de la Hispaniola, Zoológico Dominicano.

Given the variety of topics covered, we included five experts leading this event: Rosanna Carreras, INTEC University - iguana ecology and conservation; Stesha Pasachnik, San Diego Zoo - iguana manipulation and field techniques; Miguel García, Puerto Rico Ministry of Environment

- Mona Island Iguana Project; Ricardo López, Puerto Rico Ministry of Environment - Green Iguana as an invasive species; and Eveling Gavot, ZOODOM - captive management.

The program for the workshop was as follows:

#### Rock Iguanas

- Biogeography and evolution
- Conservation status and threats
- Legal status

#### Ricord's Iguana (*Cyclura ricordii*) and Rhinoceros Iguana (*Cyclura cornuta*)

- Natural history, distribution and reproduction
- Genetics

#### Conservation Biology

- Generalities
- Conservation goals for Rock Iguanas in the Caribbean
- Preserving genetic diversity, ecological integrity and population health
- Threats to biodiversity: habitat destruction, invasive species, outbreeding and inbreeding - Examples from the Dominican Republic

#### Iguanario Genetics

- Wild populations vs. Captive populations
- Identifying current threats for each population
- Identifying proper conservation measures to take on each iguanario

#### Iguana Husbandry

- Quarantine
- Facilities and food requirements
- Data collection and record keeping
- Health status and medical inspections
- Confiscated animals: destination and management





Presentation during the group activities outlining achievements and difficulties faced at their iguanario. Left to right: Héctor Andújar, Yakawell Tejada, and Jomely Solano.

### Conservation and Management

- Recovery plans vs. Management plans: Recovery plan for Ricord's Iguana
- Monitoring plans for re-introductions
- Re-introduction programs: When are they good?

### Head-starting Program and Re-introductions for Rock Iguanas in the Caribbean

- Mona Island Iguana Example, *Cyclura stejnegeri* - Puerto Rico

### Green Iguana (*Iguana iguana*) as an Invasive Species

- Natural vs. Invasive distribution
- Legal status
- Threats to the environment in Puerto Rico
- Management and control

Several group activities were performed to increase teamwork and to allow each participant to be directly involved in the evaluation of each iguanario and in the decisions to improve the conservation of the species.

### Group Activity 1

Participants from one or two iguanarios were grouped together to discuss what they have accomplished in the past year and identify the difficulties in implementing changes into their facilities. They also were asked to identify the specific purpose their iguanario, such as an educational facility, exhibition only, conservation, to implement a reproduction program, etc. The idea being that each organization likely has a different focus and making sure that focus is clear will help us determine how we can help them address the issues they face and prevent threats from continuing. They were also asked to brainstorm ideas for an implementation of an Iguanario Management Plan and how they think their facility could participate.

### Group Activity 2

Iguana Manipulation and Field Techniques. The entire group was taken to Outback Adventure Ranch to visit the new iguanario found in the spring 2015 visits and to evaluate it. They had a tour of the Ranch and a demonstration in animal handling and data collection techniques. Many workshop participants had the opportunity to be involved in this hands-on activity, and there was ample time for questions and answers throughout the day, often in group sessions. This activity reinforced interactions between iguanario participants.

### Group Activity 3

At the end of the workshop, all the participants gathered to discuss topics of interest that came up during the meeting. This dynamic is very popular among participants, as they enjoy the opportunity to talk, share ideas, voice concerns, and make recommendations. In this second meeting, the Green Iguana as an invasive species was brought up as a topic and there was a lot of interest on behalf of the group to share ways that we can help control this situation.

**Post-Workshop Presentation.** An oral presentation was given at the XI International Congress of Scientific Research (in Spanish: XI Congreso Internacional de Investigación Científica) by Rosanna Carreras De León and Stesha A. Pasachnik entitled "Husbandry and education capacity building to support *Cyclura* conservation in the Dominican Republic" during June 10-12, 2015 at the Autonomous University of Santo Domingo, Dominican Republic.



Participants in the 2015 Workshop (left to right) - Back row: Germán Santana, Carlos Roa, Francisco A. Solano, Yakawell Tejada, Jomely Solano, Antonio A. Cabral, and Juan Ramón Mirabal. Second row: Punta Cana Reserve staff, Stesha A. Pasachnik, Héctor Andújar, Félix Bruno, and Ignacio Quezada. Third row, seated: Karina E. Hierro, Evelyn Gavot, María I. Pérez, Miguel A. García, Rafael Rodríguez, Rosanna Carreras De León, and Anja Grimm. Front row, seated: Ricardo López Ortiz, Carolina Dávila, and Miguel Betances.

## Allen Cays Rock Iguana (*Cyclura cyclura inornata*)

Results of Allen Cays Iguana Study 16 to 22 May 2015.

John B. Iverson, Department of Biology, Earlham College, USA

This was the 35th year of our studies of the Allen Cays Iguana in The Bahamas. With a team of six undergraduates each (plus five total faculty) from Earlham College and Denison University, we captured 304 iguanas (81% of them recaptures) on Leaf Cay, and 151 on U Cay (65% recaptures). We have now accumulated over 7,500 iguana captures on these two cays over our 35-year study! See Table 1.

Early in our study in the 1980s, sex ratios on these cays were biased toward males by a ratio of two to one. Over the subsequent three decades they steadily moved toward the expected one-to-one ratio, but are now moving toward female biased ratios. For example, the sex ratio of captured iguanas on Leaf Cay this year (126 males to 156 females) was nearly statistically biased toward females ( $p = 0.07$ ), compared to 133 males to 135 females in 2013, 102 to 101 in 2011, and 92 to 102 in 2010. In addition, the sex ratio of captures on U Cay has been significantly skewed toward females for several years (54 males to 91 females this year, 37 to 52 in 2013, 28 to 46 in 2011, and 20 to 49 in 2010). We continue to believe that these latter biases are in part due to the unexplained disappearance of most of the large, relatively tame males that came to the main beaches to be fed by tourists in recent years. We suspect that the large iguanas have been killed or removed by humans, either for food, the pet trade, or to reduce physical risk to ecotourists feeding them. This disappearance is reflected in



Yawning subadult. Photo by Sarah Higdon (above).  
Processing team on Leaf Cay. Photo by Lynne Pieper (below).



Figure 1 and shows that the average size of the largest ten males and ten females from Leaf and U Cays has declined significantly ( $p \leq 0.01$ ) over the last 20 years.

The attraction of iguanas to the feeding beach on Leaf Cay continues to increase with the increased human traffic (i.e., feeding). This year, despite our active attempts to survey the entire island, 56% of all Leaf Cay captures were made on that main feeding beach, which represents only about 5% of the total island area. Furthermore,

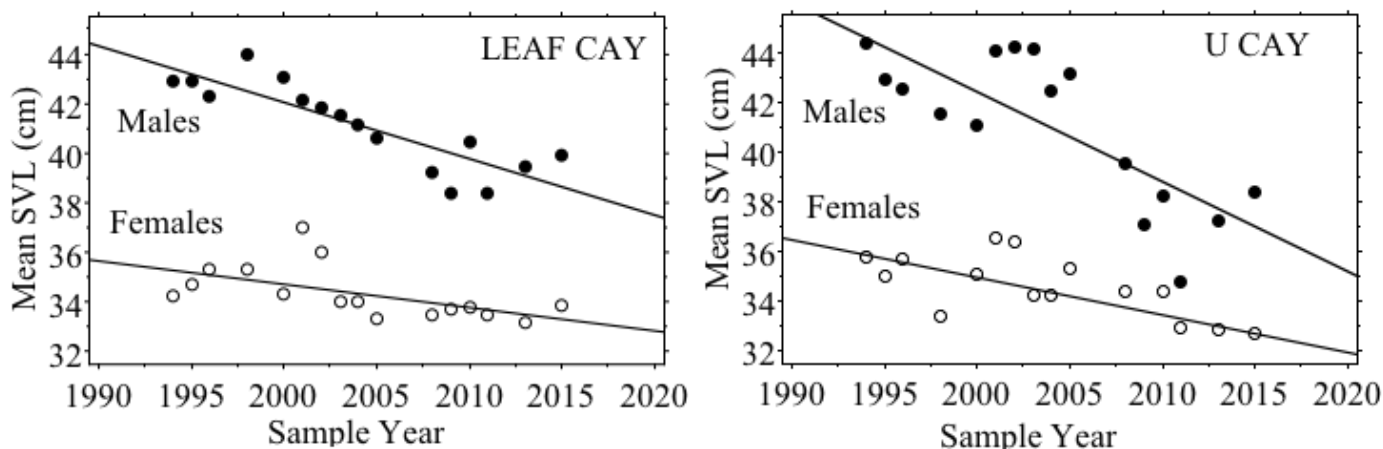


Figure 1. The frequency of Allen Cays Rock Iguanas with tail breaks remains low overall (6.4% on Leaf Cay, 7.4% on U Cay), but rates were higher for females on Leaf Cay (9.0% for females, 3.2% in males), but higher in males on U Cay (9.3% vs 6.6%). We will continue to monitor this, but we believe this variation is just sampling bias. We do not know the causes of tail breaks (e.g., depredation attempts, sexual aggression). Regression lines are statistically significant at  $P < 0.01$ .



Table 1. Recapture information by year for Allen Cays Rock Iguanas. Abbreviations are: caps (captures), recaps (recaptures), and Cum (cumulative). Total number of captures for U Cay is 2,501 (619 + 1,882) lizards, and for Leaf Cay it is 5,005 (1,326 + 3,679). All trips in 1980 through 2000 were in mid-March. Trips in 2001 and 2002 were in mid-May and mid-June to mid-July. Censuses in 2003-2015 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	1,049
2001 <sup>a</sup>	140	110	79	435	933	284	220	77	679	1,274
2001 <sup>b</sup>	40	34	--	441	967	209	89	--	799	1,363
2002 <sup>c</sup>	143	118	83	460	1,085	350	266	76	880	1,629
2002 <sup>d</sup>	37	34	--	463	1,118	147	72	--	945	1,701
2003 <sup>e</sup>	102	95	93	470	1,213	214	204	95	955	1,905
2004 <sup>f</sup>	124	112	90	482	1,325	376	257	69	1,074	2,162
2005 <sup>g</sup>	108	96	89	492	1,421	246	221	90	1,093	2,383
2008 <sup>h</sup>	114	94	82	512	1,515	289	245	85	1,137	2,628
2009 <sup>i</sup>	81	69	85	524	1,584	198	173	87	1,162	2,801
2010 <sup>j</sup>	71	55	77	540	1,639	220	190	86	1,192	2,991
2011 <sup>k</sup>	77	66	86	550	1,705	240	207	86	1,220	3,198
2013	97	80	82	567	1,785	291	241	82	1,270	3,439
2015	151	97	65	619	1,882	304	240	81	1,326	3,679

<sup>a</sup> Excludes 1 additional capture on Allen Cay.

<sup>b</sup> Excludes 6 additional captures (including 1 recapture) on Allen Cay.

<sup>c</sup> Excludes 6 additional captures (including 3 recaptures) on Allen Cay.

<sup>d</sup> Excludes 1 additional capture (a recapture) on Allen Cay.

<sup>e</sup> Excludes 7 additional captures (including 4 recaptures) on Allen Cay.

<sup>f</sup> Excludes 9 additional captures (including 7 recaptures) on Allen Cay.

<sup>g</sup> Excludes 6 additional captures (including 5 recaptures) on Allen Cay; 3 new captures on 2nd small cay north of Leaf Cay.

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

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

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

<sup>k</sup> Excludes 7 additional captures (5 recaptures, 1 skeleton) on Allen Cay.



we examined growth rates over the past 20 years of iguanas from the west (fed) side of Leaf Cay versus those from the east (unfed) side of Leaf Cay versus those from U Cay (fed, but less so than Leaf Cay). Not surprisingly, we found the fastest growth on western Leaf Cay, followed by that on U Cay, with the slowest growth on the east side of Leaf Cay where iguanas are never fed by humans. These results provide one more increasingly significant effect of humans on these iguanas.

We also noticed that Leaf Cay iguanas were shedding large flakes of skin at a significantly higher frequency (35%) than those on U Cay (22%). Whether this difference is related to the elevated levels of supplemental feeding by tourists on Leaf Cay (and concomitant increased growth rates) is uncertain, but is our best hypothesis.

**New Research.** University of San Diego Master's student Kristen Richardson has nearly completed her research on the use of stable isotopes in the tissue samples of Allen Cays Iguanas to determine their dietary history [ratios of isotopes in an animal's tissues reflect the ratios of isotopes in the organisms they have eaten in the past]. Her preliminary data indicate that iguanas on all islands (including Allen Cay where the gigantic iguanas live) are primarily herbivorous. However, the Allen Cay food web is significantly enriched with nitrogen, presumably from the guano and carcasses from the colony of nesting Audubon's Shearwaters there. It appears that the plants on Allen Cay have higher nitrogen content, which may be driving the increased body size of the iguanas through higher food quality. Kristen intends to finish her thesis by the end of the summer.



Earlham Professor Wendy Tori with iguana. Photo by Joe Ignacio Pareja (left). Student Elizabeth Postema with captured iguana. Photo setup by Elizabeth (above). Adult male Allen Cays Iguana, *Cyclura cychlura inornata*. Photo by Wendy Tori (left).

**PIT Tags.** This year we implanted an additional 90 microchip (PIT) tags in iguanas, and have now PIT tagged a total of 1,009 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 (\$8 per tag), because the redundancy of using both methods simultaneously ensures the positive identification of every iguana so marked. We found several interesting instances of the migration of a PIT tag from its original subcutaneous injection site anterior to the left hip. In three of those cases, the migrated tag was located mid-ventrally, in the right abdominal area, and in one it was found inside the base of the tail!

**Climate Patterns.** Unfortunately, our rain gauge was inoperative over the last year (Table 3). Hence, we were unable to quantify the abnormally wet spring experienced by The Bahamas. The vegetation was more luxuriant in May than we had ever seen it, no doubt reflecting the high rainfall in the Allen Cays. This pattern of excess rainfall during the spring dry season was similar to that in 2012.

**Allen Cay Renovation Project Update.** We only had time to send a small team to Allen Cay for a half day this year, to follow up on the impacts of



Table 2. Tally of PIT (passive integrated transponder) tags deployed and their success rates for Allen Cays Rock 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 2001-15 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 <sup>a</sup>	6	185	65	0	0	20	255	65	2	0
2003 <sup>b</sup>	14	199	58	0	0	52	307	66	3	1
2004 <sup>c</sup>	15	214	65	0	0	51	358	106	1	0
2005 <sup>d</sup>	10	224	50	0	1	52	410	105	0	1
2008 <sup>e</sup>	32	256	27	0	0	74	484	100	0	2
2009 <sup>f</sup>	8	264	41	0	2	30	514	124	1	1
2010 <sup>g</sup>	15	279	45	0	0	21	535	129	0	2
2011 <sup>h</sup>	23	302	43	0	0	42	577	135	4	0
2013	8	310	63	0	0	32	609	165	0	1
2015	35	355	61	0	0	55	664	139	0	0

<sup>a</sup> Excludes PIT tags placed in 3 iguanas on Allen Cay.

<sup>b</sup> Excludes PIT tags placed in 5 iguanas on Allen Cay.

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

<sup>d</sup> 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 a tag.

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

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

<sup>g</sup> 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.

<sup>h</sup> 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 (in inches) recorded in digital 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, 11 May 2012 to 19 March 2013, and 15 May 2014 to 13 April 2014. 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	<b>0.00</b>	0.02*	--	--	--	--	--	--	--
2010	--	--	--	--	0.36*	1.86	4.15	5.13	6.62	<b>16.11</b>	0.32	2.94
2011	0.96	0.03	0.43*	--	0.12*	2.08	1.97	<b>6.86</b>	6.67	6.95	2.49	1.04
2012	0.24	0.86	1.37	<b>6.50</b>	<b>7.64</b>	<b>6.55</b>	3.17	4.64	2.51	6.12	0.25	2.03
2013	<b>0.02</b>	0.39	0.47*	--	6.86	2.84	3.78	2.28	4.09	3.69	<b>4.68</b>	1.18
2014	<b>3.83</b>	0.85	0.51	0.02*	--	--	--	--	--	--	--	--
means	1.18	0.53	0.67	3.25	7.25	2.89	3.22	4.61	5.09	7.39	1.99	1.77

\* partial month only



Adult male Allen Cays Iguana, *Cyclura cychlura inornata*.  
Photo by Wendy Tori.

the mouse eradication in 2012. They walked the entire the island and neither saw nor heard any iguanas, but did see tracks on the landing beach as well as on the artificial nesting site north of the landing beach. We intend to do a more thorough survey in 2016 and also create more new potential iguana nest sites by filling another sink hole with beach sand. Also, a few more iguanas that were translocated from Allen Cay to Flat Rock Reef Cay during the Allen Cay mouse eradication have not yet been returned to Allen Cay. It is our intention to capture and return them in May of 2016.

**Future Plans.** We plan a full survey of the Allen Cays in both May of 2016 and May of 2017. Priorities in 2016 will include thorough surveys of Flat Rock Reef and Allens Cays, shorter surveys of Leaf and U Cays, and a much more intensive survey than usual of the introduced population of Acklins Iguanas (*Cyclura rileyi*) on Bush Hill Cay that we have also been studying since 2002.

**Acknowledgments.** This work would not have been possible without the continued support by 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 the International Iguana Foundation, ZooAtlanta, the late Dr. Ned and Sally Test, the Cope Museum Fund of Earlham College, and 140 different Earlham College students (and eight faculty) and 18 Denison University students (and three faculty) over the past 35 years is also greatly appreciated.



## Sister Islands Rock Iguana (*Cyclura nubila caymanensis*)

### Update on SIRI Population Status, Actions Taken, Challenges Faced.

IIF Grant Report submitted by Jeanette Moss, Mississippi State University, USA.

The work conducted on Cayman Brac and Little Cayman this year, with the support of the International Iguana Foundation, represents a preliminary assessment of the current Sister Isles Rock Iguana (SIRI) population and its nesting activities. IIF funds were combined with a generous grant from the Mohamed bin Zayed Species Conservation Fund to support Jen Moss's travel to Cayman Brac for a 10-day sampling trip in March 2015, as well as travel (Jen Moss, Matt Goetz, and Glenn Gerber) to Little Cayman over SIRI's nesting season, from early May through end of June.

Since Matt Goetz's first island-wide nesting surveys were conducted on Little Cayman from 2007-2010, the Cayman Islands National Trust has made great strides towards protecting their native reptiles. Thanks to massive fundraising success in the local communities, new protected areas have been established, iguana crossing signs have been distributed on all the roads to limit road-kills, and a new nature boardwalk has been opened at Preston Bay to encourage an appreciation for natural beach communities. At Mahogany Bay, a roadside site where tourists once flocked for the experience of feeding iguanas, harmful activities have been put to a stop and the resident iguanas have apparently receded back into their natural habitats. Further yet, Mike Vallee (Little Cayman dive master) has recently raised the funds to launch a "Green Iguana Be-Gona" campaign, which will aim to control the spread of invasive green iguanas on the island by using drones to locate the animals in otherwise impassable swamps and dense forest.







Despite these efforts, preliminary observations of the Little Cayman iguana population are suspected to reflect a further decline since Goetz's study. Large tracts of shrubland have been cleared for planned subdivisions, though the overgrown and deserted roads have yet to see any further development. Plans for a new airstrip that would supposedly have increased tourism to the island were thwarted by multiple sinkholes, but the land was left highly disturbed. Feral cat sightings (including at active nest sites, where one was even trapped unintentionally), and road-kills due to speeding cars (six were reported during our study period, of which one was a still-gravid female) are sadly still regular occurrences. Mating and nesting season (early spring through late summer) see particularly high road mortalities as animals are moving out of their home ranges (frequently crossing roads from the interior onto the coast) in search of mates and nesting areas. Rallying concern for these problems within the local community has been a constant struggle due to the disproportionately dense congregations of animals around areas of human activity. The old museum lot – where for years iguanas were fed on a daily basis – is a special case, supporting over 50 animals within its artificially small territory. Occurrences such as these unfortunately lead to gross misrepresentations of the true population status.

According to local accounts, noticeably fewer iguanas are seen roaming the island compared to five to ten years ago, when Goetz began his work. More concerning is the low representation of younger age classes among the animals sampled (approximately 20-30%), though the population's true recruitment success remains to be investigated. The density of nesting iguana appears at first glance to be lower at revisited

sites, and the habitat suitability of large communal nest sites (in particular, Preston Bay) appears reduced by excessive palm leaf litter and coconut debris. While coconut palms have been part of the natural plant communities since their Polynesian introduction hundreds of years ago, their high density within the beach communities is suspected to be an artifact of human colonization. Indeed, pervasive habitat degradation and disturbance to Caribbean ecosystems has the added negative side effect of allowing early-successional plants (such as Acacia and Love Vine) and non-natives like Australian Pine to rise to dominance, spelling out long-term problems for habitat restoration. Additionally disconcerting, is the expanding market for beach properties along the entire coastline, including lots adjacent to important protected areas like Preston Bay. It will be important to determine what kind of toll these developments have taken, and might take, on the long-term viability of the species.

On the other hand, new nest sites were identified this summer that may reflect a shifting of nesting activity correlated with changes (likely both natural and artificial) in suitability of island habitat. While Preston Bay remains the most densely utilized communal site on the island (23 nests), significant activity at other coastal sites such as the Airstrip site (9 nests) and the Northwest site (5 nests) where little activity had been previously recorded, suggest that more island-wide surveys may be necessary to identify important nesting areas. Further, two nests were identified at an interior shrubland site on Spot Bay Road, whose resident iguanas were previously thought to disperse to the coast to nest. This observation demands closer attention to small patches of suitable substrate in the island's interior, as these areas may support more nesting activity than was originally presumed. The use of high-resolution aerial imagery and scouting drones, combined with radio-telemetry data from dispersing iguanas, may facilitate these findings.



*Matt Goetz prepares to release an iguana in her burrow.*



Another take-away from the close daily monitoring of nest sites throughout this study has been to shed new light on the entirely individualistic behaviors of these animals. Investigations of disparate nesting strategies found that individual behavior is near impossible to predict based on site data alone, and that more thorough investigations will be needed to understand SIRI nesting strategies. Specifically, the number of test digs made, the re-purposing or sharing of existing digs and nests, the construction of unique entrance tunnels, and the time spent sealed underground and/or guarding are all poorly understood SIRI behaviors that warrant further study, perhaps by use of trail cameras and/or geological ultrasounds.

While very successful in terms of total numbers surveyed and sampled, this field season was not without its challenges. Fewer inland nest sites were identified than anticipated due to their insular and patchy distribution and the impenetrable nature of Little Cayman's interior shrubland habitat. Next season's efforts should incorporate conservation drone technology and high definition aerial imagery to identify patches of nesting substrate in the island's interior.

Study sites were visited only once or twice daily to limit disturbances, and new activity was recorded. Ongoing observations of individual behavior were made possible only by capturing and marking individuals with unique bead combinations. Many captures were thwarted at active nest sites due to limited personnel and unpredictable behavior of nesting females. It was difficult to trace a particular female to her nest, since not all females stayed behind to guard after closing. Many animals were very skittish and evaded capture, so efforts were made to capture animals opportunistically wherever possible. Occasionally, females were still gravid when captured or had already dispersed from their nesting sites. Thus, logging the activity of individual nesters



Volunteer TayVanis Oyog provided essential help in the field.



nas, and many data points (days sealed inside, days guarding, etc.) were incomplete.

Excavation efforts posed an additional challenge to this year's study. The intention was to excavate all identified nests to investigate tunnel dimensions, locate egg chambers, and collect clutch data. However, many nests could not be fully excavated due to the length and depth of the entrance tunnels and the time commitment that would be required. Further, many excavations were postponed until the end of the study to limit disturbances to active communal sites, but by that time it was discovered that excessive rain and age had made tunnel identification impossible. In the end, 20 partial excavations were carried out and a total eight egg chambers were found.

#### Results Summarized:

Cayman Brac (March 7-14):

- 24 iguanas processed (10 recaptures, 14 new; 4 <yearlings).
- 23 blood samples taken.

Little Cayman (May 3-June 30):

- 137 iguanas processed (28 recaptures, 109 new; 26 <yearlings).
- 128 blood samples taken.
- 6 road mortalities observed.
- 74 nests identified (found closed between May 9 and June 29).
- 24 nests with known female IDs, 16 with precise guarding times collected.
- 20 nests partially excavated.
- 8 egg chambers found (5 with known female IDs) with clutch sizes between 3 and 20 and egg masses between 50 and 71 grams.

#### Next Steps:

- Analyses of genetic data (2015 ongoing).
- Hatchling success study (August 2015).
- Identification of more inland sites using conservation drones, HD aerial imagery (summer 2016).
- Dispersal studies (summer 2016).





## Anegada Rock Iguana (*Cyclura pinguis*)

### Fall 2015 Anegada Rock Iguana End of Year Program Report.

IIF Grant Report submitted by Kelly A. Bradley, Fort Worth Zoo, USA.

The Critically Endangered Anegada Rock Iguana has been the focus of a long-term headstart-release program designed to offset high juvenile mortality resulting from the large feral cat population on Anegada. Each year iguana nests are identified during the summer nesting season and the resulting hatchlings are collected in the fall to be raised in a safe captive facility on Anegada. Once these captive iguanas reach a larger less vulnerable size (400 g body mass and 20 cm SLV), they are released back into the wild. The population was estimated to be 200-300 animals prior to this conservation initiative. Encouragingly, headstarted animals exhibit high survival rates in the wild (79%) and the population has doubled to an estimated 400-500 animals. Despite these successes, the Anegada iguana remains conservation dependent, and the current increasing population trend will cease if actions on the ground stop. Despite ongoing challenges, the 2014-2015 field season proved to be very successful and the following report details important accomplishments from the past year.

**Camera Trapping Effort.** The Anegada Iguana is extremely wary and very difficult to observe in the wild. In 2010 a pilot study using trap cameras was conducted and proved to be successful at gathering data that would be impossible to collect otherwise (e.g. presence of iguanas outside the core iguana area, long-term survival of headstarted animals, and reproduction of headstarted animals). During the 2014-2015 field season

cameras were used at Bumperwell Cay, Windlass bight, and Low Cay. All camera-trapping surveys collected numerous images of released and wild iguanas, feral cats, donkeys, cattle, and goats.

**Bumper Well Cay** - In late October at the end of the 2014 field season, camera traps were setup in a transect along the northwestern portion of the cay where iguanas are known to occur. These camera traps continuously collected images while Bradley was off island until 18 May 2015, for a total of 212 trapping days. The survey identified a minimum of six individuals using differences in the physical characteristics of nuchal crest, tail, and crest scales (Figs 1-6). Because of the length of this trapping event and the high number of different cameras that picked up the same animals, the results will be used to create rough home-range estimates for at least two individuals.

Prior to this camera trapping effort, very little was known about the population dynamics in the area of the island, even though it is in what is considered the core iguana area. The results from this survey shed light on the basic age and health of individuals in this area; documenting that in spite of heavy goat presence on the cay, it is a healthy group in which individuals are in close contact with each other. Based on these results, a large portion of released headstarted iguanas will be released on Bumper Well Cay in 2015.

**Windlass Bight and Faulkner House** - The cameras were set up in front of known iguana burrows in the Windlass Bight and Faulkner house during May and early June. Two groups of student volunteers worked on the portion of the survey, baiting cameras daily. These areas are surveyed each year in order to conduct long-term monitoring of wild and headstarted iguanas, in two of the densest areas in the core iguana area. Iguanas at both sites continued to do well and all animals appeared to have good body condition despite the severe drought in the BVI. Cameras documented both older wild animals and younger headstarted animals.

**Low Cay** - During July two groups of student volunteers set the cameras in two grid arrays at separate locations on Low Cay (largest cay in western salt ponds) for one week per grid. The traps were baited twice a day. Several wild adults were photographed plus many headstarted animals released in 2011 and in 2014. In addition, three headstarted animals were captured and growth data were collected. Unfortunately numerous cats, goats, and cattle were also identified on this cay. Cameras will be set up on the western portion of this cay in late November and left until May 2016. This survey will cover much of the cay that has yet to be surveyed.



A wild, young female Anegada Rock iguana captured by a camera trap on Bumper Well Cay.



Wild adult male Aneгада Rock Iguana captured by camera trap on Bumper Well Cay and a feral cat in the same location.

**Aneгада Iguana Festival.** One of the key challenges is the small, but politically vocal human population on Aneгада. Unfortunately many local residents are suspicious of government and outsider activities on Aneгада. The program initiated an annual Iguana Fest in 2012 to facilitate communication with local residents and to provide a forum for education activities. The 3rd Annual Aneгада Iguana Fest was held in October 2014. The festival raised public awareness of the Aneгада island ecology, with special attention paid to the Aneгада Iguana. The event was held on the local British Virgin Islands (BVI) holiday, St. Ursula's day, when most of the BVI residents had the day off from work. The day was also a regular ferry day, allowing residents from Tortola and Virgin Gorda to attend the festival. This change in schedule resulted in a record attendance of close to 200 people. A large portion of the Spanish speaking population from the Dominican Republic also participated, helping us reach a new demographic group on Aneгада.

The event included a one-mile and 3 mile fun run/walk for children and adults, a light breakfast for race participants, tree-planting ceremony at the headstart facility, guided tours of the proposed protected area for iguanas and the headstart facility. A local DJ provided music for most of the festival. As in years past there was a free hot-dog cookout and iguana cake. To commemorate the event and maintain visibility after the festival, an official Iguana Fest T-shirt was created and approximately 250 shirts were given out festival participants. The BVI Tourist Board plus six local businesses sponsored the event and their logos were added to the event's T-shirt.

The Fort Worth Zoo's (FWZ) Education Department developed several high-activity games that demonstrated different aspects of the islands ecology and local wildlife. The games illustrated the flow of energy through the ecosystem; how iguanas are seed dispersers and maintain a healthy forest community; how invasive feral mammals negatively affect the native

iguana population, and how mangroves help reduce erosion. Two weeks prior to the festival, Bradley visited the local school and senior citizen center to announce an art contest to be held in conjunction with the festival. All submissions were displayed at the event; ribbons and cash awards were presented during the festival.

The 4th annual Iguana Fest took place on October 19th 2015, St Ursula's Day (Figs 7-8). The events closely followed last year's, with new ecology games and a new official festival T-shirt. A large school group (25 students) from the neighboring island of Virgin Gorda (also part of the Ninth political district with Aneгада) attended the event. The event was very successful and had a record number of children in attendance.

**Release of Headstarted Iguanas.** In October of 2014, 18 animals were released back to the wild. This brings the total number of released animals up to 195. Four animals were chosen for a public release with local schoolchildren in the Boneless Bight area of the core iguana area. The 14 remaining animals were released at the central portion of the main body of Low Cay. This is second release on the cay, the first being in 2011. However the first release was on the north-western tip of the cay.

The 13th annual release of headstarted iguanas will take place in early November 2015. An estimated 12-13 animals will be released. This







will bring the total number of released head-started iguanas to over 200. Most animals will be released on Bumperwell cay to supplement this segment of the Anegada population surveyed in fall 2014- spring 2015. Three to four animals will be released in public event involving local school children in the Bones Bight area of the core iguana area.

**Nesting Surveys/Hatchling Collection.** Surveys were conducted in the core iguana area, Coopers Rock, and Loblolly Bay area on Anegada in July 2015. Four nests were located in the Windlass area, plus one on Middle Cay. Nesting activity was observed in Lobolly Bay, but only test digs were found before Bradley left island. This location is a new area not previously surveyed and will be closely monitored for future nests. Nests began hatching in early October 2015. As of the end of October 39 hatchlings have been collected. However 19 hatchlings were used for the hatchling survival/ecology study. All study participants still alive at the end of the study in early December will be captured and transferred to the headstart facility.

**New Facility Cages.** The program received funding from the Disney Worldwide Conservation Fund to purchase new cages for the headstart facility (Figs 9-11). Cages were manufactured by A Thru Z Consulting (Tucson, AZ), and shipped to Anegada. IIF provided funds to facilitate the final construction of the cages and the tables on which the cages sit. The project was completed in mid October, in time for the cages to be presented to the public at the 4th annual Iguana Fest. Fifty-two new cages were added to the facility enabling most captive animals to be housed separately ensuring faster growth rates. The new enclosures directly address two problems specific to the old cages, namely the warping of wood doors and dividers between cages, both of

which allowed accidental early release and animals to move between cages. For the first time, all new hatchlings will be housed individually.

**Hatchling Survival/Ecology Study.** Bradley is currently repeating the 2013 hatchling survival/ecology study (Figs 12-13). Nineteen hatchling iguanas from 4 different nests were selected to be part of the study. Each animal had a radio-transmitter attached and was released at the hatchling's original nest site. Hatchlings will be tracked until early December, at which time all surviving hatchlings will be collected and transferred to the headstart facility on Anegada. Hatchlings are exhibiting a surprising dispersal distance including swimming across the large western salt ponds (Red Pond and Flamingo Pond). To date four animals have died because of snakes (*Borikenophis portoricensis*) and three because of cats. Animal locations are recorded daily using a Trimble GPS and ecological relevant information (closest plant species, height above ground, behavior, sun exposure value, etc.) is recorded for each observation.

**Plans for 2016.** In addition to the items listed in the 2016 IIF grant submitted for the Anegada Iguana program we hope to complete the following items:

- Bradley, K. Treiber, and G. Gerber intend to submit a paper titled "Growth and body condition index of headstarted Anegada Iguanas released to different habitat types on Anegada, British Virgin Islands" for publication by the end of the 2015.





- Iguana Fest 2016 - Next year's festival will be the fifth year for this annual event. There are plans to increase adult participation by: 1) selling alcohol, 2) have local businesses sell food, and 3) have a large raffle for donated prizes geared towards adults.
- Work with Dr. Rob McCarthy (Tufts University vet school) to conduct a cat and dog spay/neuter event for Anegada residents in the summer of 2016.
- Work with Dr. Martin Hamilton (Royal Botanical Gardens, KEW) to investigate the seed dispersal ecology of the Anegada Iguana. This study will include: 1) fecal analysis/dietary study; 2) gut passage time experiments; and 3) germination time experiments. It was originally planned to conduct these experiments in 2015, but Anegada was experiencing a strong drought and plant materials were not available for the gut passage or germination experiments.



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**Annual ISG Meeting 2016  
1-4 November**

**Held at the Musket Cove Island Resort &  
Marina on Malolo Lailai Island, Fiji**  
Check the [website](#) for details!



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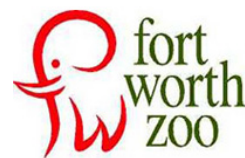
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