



iguana specialist group

NEWSLETTER

Volume 17 · Year 2017



*Yucatán Spiny-tailed Iguana
(Cachryx defensor)
See page 3 for more on this species*



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



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Cover Photo

Cachryx defensor, previously known as *Ctenosaura defensor*. Photo by Joseph Burgess.

Ctenosaura defensor and *Ctenosaura alfredschmidti* have recently been changed to the genus *Cachryx* (see Malone, *et al.* 2017. *Molecular Phylogenetics and Evolution* 115: 27–39). This small bodied, arboreal lineage was originally described by Cope in 1866. He gave it the genus name *Cachryx*, from the Latin *Cachryo*, meaning catkin or parched barley, in reference to the shape of the tail.

ISG Updates

Updates from the Co-chairs and Program Officer

Red List Assessments. In 2014, the ISG pledged by 2020 to complete IUCN Red List assessments for all iguana species while maintaining updated assessments for species within a 10-year publication window. These goals align with the wider IUCN assessment goals to reach 160,000 species, of which reptiles are a priority. We need active participation from ISG members to reach this goal, and we appreciate that significant progress was made in 2017. We anticipate that at least four updated assessments will be published in 2018. Notably, we expect that *Iguana delicatissima* will be reassessed to Critically Endangered because of the continuing threat of displacement by, and hybridization with, non-native Common Green Iguanas (*Iguana iguana*).

New Additions to ISG Leadership and Members. In 2016, the ISG Steering Committee (SC) approved a transition plan that provides a transparent and accessible path for members interested in serving on the ISG SC. The transition plan includes 3-year, non-binding rotational terms. Each year, two SC members will rotate off the committee, allowing new members with the highest vote tallies to join. Rick Hudson and Allison Alberts ended their terms as SC members and as mentioned in previous newsletters, were among the founders of the ISG. In their place, we welcomed Bonnie Raphael and Joe Burgess to the SC and look forward to working with them to advance the mission of the ISG. We also welcomed new ISG members Steve Anstey, Judith Bryja, Susannah French, Kyle Miller, Jose Luis Herrera-Giraldo, Wesley Jolley, Scott Keogh, Daisy Maryon, Araceli Samaniego Herrera, and Thijs van den Burg. We

look forward to their participation in ISG efforts to study and conserve iguanas.

Invasive Iguana Position Statement Updated. In 2016, the ISG published a Position Statement, which explains the risks of non-native iguanas to regions outside their native ranges, emphasizes the devastating environmental and economic impacts they cause, documents known regions of invasion, and provides recommendations for countries dealing with various stages of invasion. The intent of the statement is to inform policy makers, wildlife managers, and the public on this critical topic with the intent to catalyze action on islands experiencing invasions. The document was intended to be updated periodically when new information became available. In 2017, we updated the statement with input from various ISG members at the Cuba meeting and it can be accessed from the ISG website. Please share this document widely with your collaborators.

https://www.iucn-isg.org/wp-content/uploads/2017/12/IUCN_SSC_ISG_Invasive_Iguana_Position_Statement_Dec2017.pdf

Action Plans. At the 2017 annual meeting, we discussed our current state of species action plans while introducing the concept of publishing one large action plan for the subfamily Iguaninae. Benefits for including all species under one plan include 1) increased exposure for the group through one glossy publication, 2) provides group inertia to get every species minimally assessed, 3) opens funding opportunities for all species, and 4) dovetails with the need to assess species for the IUCN Red List and to include species accounts on the ISG website. Discussions included potentially dividing the plan into smaller, more manageable regional or taxonomic groupings. We will continue to discuss potential options and work toward some type of plan(s) in the coming year. The IUCN instituted new guidelines for all publications. Starting in 2018, all specialist group action plans wanting an IUCN ISBN must have at least two external peer reviewers, with comments tracked through a table on the Union Portal, and be signed off by the Editorial Board. Other IUCN publications have different requirements. Contact Tandora for more information.

Taxonomic Updates. In 2017, ISG members Catherine Malone, Victor Reynoso and Larry Buckley published a manuscript (*Mol. Phylogenet. Evol.* 115:27–39) using data from four nuclear loci and two mitochondrial regions to test the monophyly of the morphologically similar spiny-tailed species of *Ctenosaura* currently referred

Another taxonomic modification in 2017 was published by Miralles et al. (2017. *Zool. J. Linnean Soc.* 181:678–710). The authors integrated population genetics, phylogenomics, and comparative morphology to propose an updated taxonomy of the genus *Amblyrhynchus* from the Galápagos reflecting the evolutionary history of this group. They recognized a single species with 11 divergent population clusters at the subspecies level, including five new subspecies described as *A. cristatus godzilla* subsp. nov. (San Cristóbal-Punta Pitt), *A. c. jeffreysi* subsp. nov. (Wolf and Darwin), *A. c. hayampi* subsp. nov. (Marchena), *A. c. trillmichi* subsp. nov. (Santa Fé), and *A. c.*

All our best,
Chuck, Stesha, and Tandora



2017 ISG Meeting Summary

The 2017 annual Iguana Specialist Group meeting was held from 22-27 October at the Meliá Hotel, Varadero Peninsula, Matanzas Province, Cuba. We spent the first night in Havana, Cuba at the Roc Presidente Hotel. In the morning, on 23 October, there was an optional walking tour of the historic colonial center, including handicraft shopping and visits to La Bodeguita del Media restaurant/bar and El Capitolio. In the afternoon, we departed to the meeting location, having our icebreaker that evening in the Meliá Hotel. We conducted our annual working meeting during the following three days. This included 20 oral and six poster presentations by ISG members and collaborators working in Cuba. We also focused on ISG business and had several talks and vigorous conversations focusing on biosecurity for invasive Common Green Iguanas, *Iguana iguana*, illegal trade, hurricane impacts and responses, strengthening local partnerships, and the AZA SAFE program. We also discussed updated recovery plans for all iguanas and agreed to work towards this in the coming years. We spent substantial time during this meeting working on IUCN Red List Assessments and updating our Invasive Iguana Position Statement. During the meeting, we had an optional field trip to archaeological sites at the Ambrosio and Musulmanes Caves within the Reserva Ecologica Varahicaco. On 27 October we traveled back to Havana, stopping in Zapata National Park on the way.

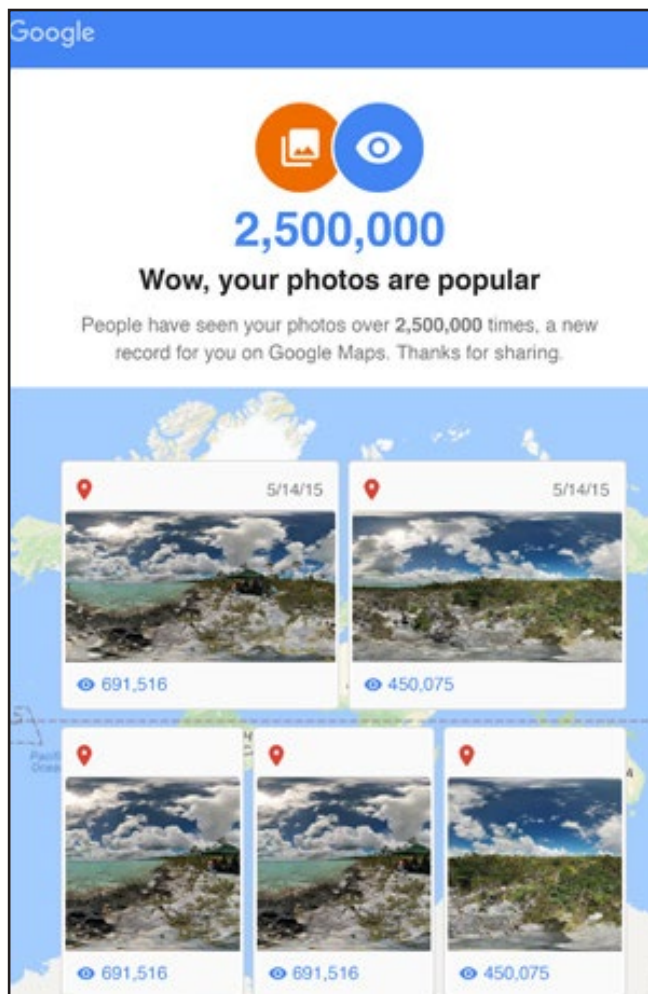
We had originally planned to hold this meeting on Cayo Ensenachos in an effort to contribute to Cuba's conservation planning, with regards to iguanas, in this region. Unfortunately, the US administration and the new regulation did not allow for this visit. We are incredibly grateful to Amnerys González Rossell and Ministerio de Ciencia, Tecnología y Medio Ambiente of Cuba for their assistance in finding an alternative location at the last minute and hosting a very productive meeting. The meeting would not have been possible without their gracious assistance.

The ISG considers it a priority to provide 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 a realistic goal of conserving iguana species long-term. We awarded six travel grants, ranging from \$500-750. We congratulate the 2017 awardees: Joseph Brown, Daisy Maryon, Jeanette Moss, Guido Rossi, and Thijs van den Burg. Edwin Castañón was also offered an award but was unable to attend the meeting due to an extenuating circumstance.

A list of meeting attendees, abstracts, and photographs can be found on our website:

<http://www.iucn-isg.org/about/isg-conferences>

Next Year's Meeting. The 2018 meeting will be held 4-8 November in Fort Worth, Texas. This location is intended to facilitate added participation from the wide range of our members. We thank the Fort Worth Zoo in advance for hosting our next meeting.



Iguana Habitats on Google Maps

Google Earth Outreach (GEO) is a small team in Google that supports organizations that "do good" in the world. In 2014, the team lent ISG member Lee Pagni a phone to capture 360-degree images (termed "photospheres") of iguana habitat as part of a project to highlight endangered iguanas. Lee then sent the camera to a few different ISG members working in the field. The photos they captured have garnered a high number of views from around the world. Although the original project page can't be

viewed (Google shifted the way they originally displayed the photospheres), the good news is you no longer need a special phone to capture photospheres. The 360-degree images are a novel way to introduce people from around the world to iguana habitat. Contact Lee if you want to contribute images to our site!



Websites Hacked

In April 2017, many of you noticed that our Iguana Specialist Group and International Iguana Foundation websites were loading pages very slowly. Content would load as normal, but switching between pages would take up to 15 seconds. At the same time, I received 2-3 random-sender, spam emails per week through our Contact Us form on the website. After two months of this, the spam increased to more than 100 per week, eventually crashed our server, that also affected the San Diego Zoo website (our pro bono host). Our sites had been hacked by someone with a Russian domain and our server was used to send masses of spam email on topics promoting "men's health". This might also explain why our website analytics showed Russian to be the second most popular language for visitors to our site in 2016.

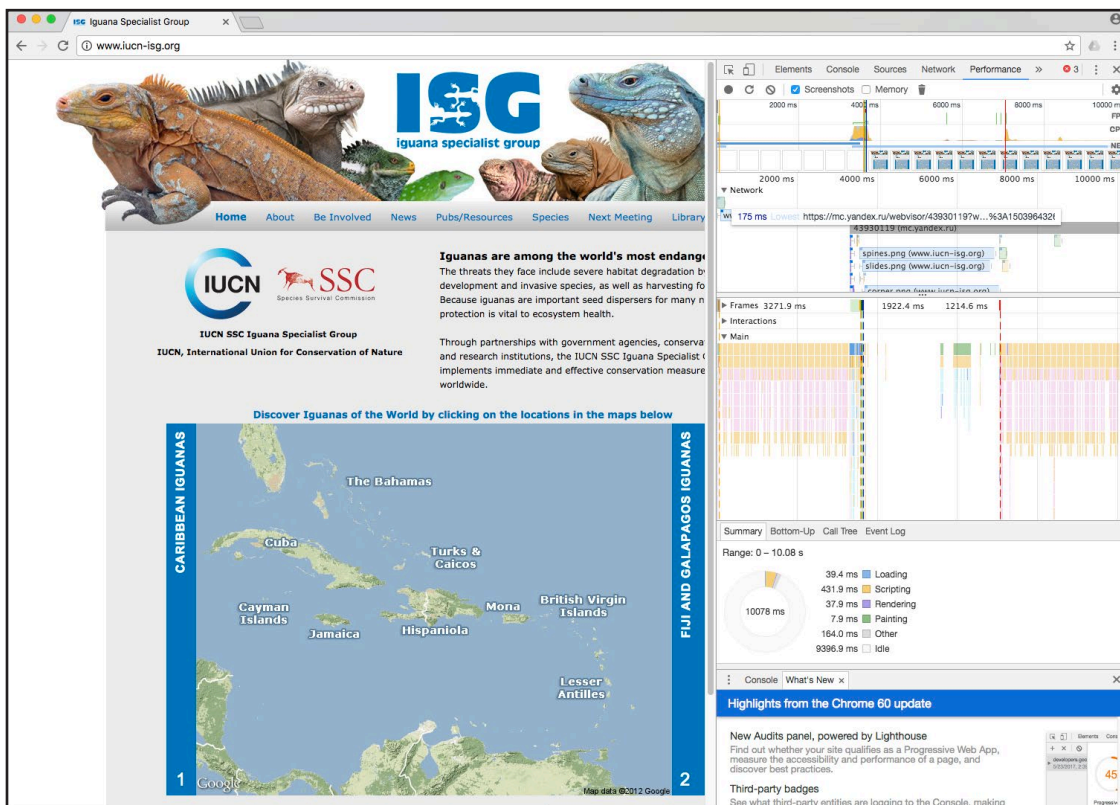
San Diego Zoo's website technology staff was able to deactivate the malicious code, but I needed to hire a professional firm that specializes in web security to "clean up" our sites and provide backups and protection from further attack. I learned that it was likely the hacker entered our site through the Contact Us form. I have since integrated several web security measures into our sites, both for forms and back-end login pages. Bot-attempts to login to the back-end of our website continue at a high rate (see screenshot).

Lessons learned, if you know anyone using low-cost website building platforms such as WordPress, Wix, etc., let them know to incorporate security tools (captcha, etc.) into any webpage forms, and always use obscure and lengthy usernames and passwords!

Tandora Grant, Website Manager



Machine-generated attempts to guess our login usernames within the editing platform of the ISG website continue at a high rate.



By using Developer Inspection Tools in a browser (Chrome, in this example), it was apparent that each time one of our pages was loaded, the site stalled because first it loads script from "https://mc.yandex.ru..." for 4-12 seconds. Once a hacker breaks into the coding side of a website, they insert scripts that run nefarious subprograms using the host's server capacity.

48 Crested Iguanas Released in the Wild

Reprinted from fijitimes.com - 27 February 2017

A total of 48 crested iguanas that were bred in captivity were released back into the wild on Monuriki Island in the Mamanuca's on Friday. This marked one of the first successful programs around the Pacific where animals bred in captivity were reintroduced to wild life.

The project which took seven years was a collaboration between the National Trust of Fiji and mataqali Vunaivi of Yanuya Village who are owners of Monuriki Island. Observations made several years ago by iguana specialists found that iguanas on the island were on the verge of extinction. This was largely because of rodents eating their eggs and hatchlings and goats eating vegetation which they depended on for survival.

Fiji is home to several unique species of iguanas found nowhere else on earth. Crested iguanas from Monuriki Island have a distinctive genetic imprint that tells them apart from iguanas found in other parts of the country. National Trust of Fiji (NTF) projects officer Jone Niukula said in 2010 they collaborated with Birdlife International in eradicating the rodents and goats. The same year they had captured 20 iguanas from the Island which they took to Kula Wild Adventure Park to breed.

In 2015, 32 iguanas produced in captivity were released into the wild. On Friday, 17 of the 20 iguanas that survived were returned to their original home and put back on the trees they were brought from along with 31 of their offsprings.

"We are grateful to the villagers of Yanuya for allowing us to conduct the project and their commitment in conserving and protecting the iguanas and their habitat," he said.

"We also understand the iguanas are also one of the tourist attractions that generates revenue for villages which reinforces the need for their protection."

NTF executive board member Craig Powell said the villagers commitment makes them fore-runners, paving the way for other villages and communities to engage in conservation efforts.

"I think it's wonderful that we can work together for an important cause and promote the sustainability of an important species,"he said.

"Our coexistence with nature is very critical.

"I think people are starting to slowly realise that we need to look after mother nature and what it has given us."

For the next six months iguana specialists will monitor the iguanas to gauge if they are thriving in their new environment. Other stakeholders that have been part of the initiative include NatureFiji-MareqetiViti, Fiji government agencies, the US Geological Survey, the Pacific Invasives Initiative, Taronga Zoo, San Diego Zoo, Los Angeles Zoo, University of Oklahoma, Durrell Conservation Academy and the International Iguana Foundation.



Monuriki Island in the Mamanuca Island group, Fiji. Photo by Peter Harlow.



San Salvador Rock Iguana (Cyclura rileyi rileyi) — smuggled from The Bahamas in 2014. Photo by Tandora Grant.

A Caribbean-Led Effort to Stop Wildlife Smuggling Takes Flight

Reprinted from U.S. Fish and Wildlife Service
27 February 2017

When people hear the word “Caribbean” they usually think of palm trees, sunny, clear skies, umbrella drinks, and delicious foods. Although it’s true that the Caribbean offers a lot in terms of the perfect getaway from the colder northern climate and the thrill of a new exotic cultural experience, it also boasts other amazing attributes. In terms of wildlife, the Caribbean is a biodiversity hotspot, with thousands of species of plants and animals.

Every year, millions of people travel to the Caribbean to revel in the warm tropical sun, cool turquoise blue water, and white (or in some places like parts of the Bahamas, pink) beaches. They also come to enjoy the wildlife, such as the over 170 endemic birds found in the Caribbean, swimming with sharks, interacting with endemic rock iguanas, and even enjoying the opportunity to watch the nesting sea turtles on the beaches! Unfortunately, there are many people who are interested in more than just observing the animals. They desire to take them and smuggle them out of the Caribbean.

Because of its rich biodiversity, the Caribbean, like many other places on earth is a prime location where smuggling occurs. For example, in 2001, a medical doctor was visiting an island in The Bahamas and tried to smuggle three Bahamian boas out of the country. The doctor was caught and sentenced.

In Trinidad and Tobago, exotic birds from South America make up the majority of animals smuggled into the country. Birds such as seed finches and Blue and Gold Macaws are highly prized birds, with seed finches being used in song-bird competitions. On the island of Hispaniola, Hispaniola Parrots have been captured and sold in the wildlife trade and are illegally kept as pets. In The Bahamas, 13 critically endangered Bahamian Rock Iguanas were smuggled out of the country by two Romanian women in 2014. They were caught and arrested at the Heathrow Airport in London and the iguanas were eventually repatriated back to The Bahamas and later released in a Bahamian National Park. Sadly, four iguanas died during the whole ordeal.

Law enforcement is an extremely important tool in the battle against wildlife smuggling. Unfortunately, in the Caribbean, wildlife crimes are not a major priority for many countries even though wildlife smuggling is a multibillion dollar black market industry and believed to be one of the largest illegal activities in the world, following drugs, arms, and human trafficking.

Fortunately, some organizations and countries in the Caribbean are working with international partners to counteract this problem. One such program is the Conservation Leadership in The Caribbean program (CLiC), which we are part of.

The CLiC program is a newly established conservation training fellowship program that provides young conservation professionals with leadership development training and an in-depth opportunity to learn from renowned Caribbean conservation leaders. Seventeen participants from 13 countries across the Caribbean have participated over the past year and a half in the first cohort, and have divided into five groups to work on conservation projects.

One of the topics is wildlife smuggling / trafficking. Participants from The Bahamas and Trinidad and Tobago have taken on the task of working on this very challenging and complex topic in their respective countries. As the CLiC Wildlife Trafficking project group, we are working towards a vision of a wildlife trafficked free Bahamas and Trinidad and Tobago. One of the key tools we have developed are two Trafficked Species Identification Guides to assist enforcement agencies in the identification of protected species.

Scott Johnson, Science Officer at The Bahamas National Trust (BNT) and CLiC Wildlife Trafficking group member has been working with several enforcement agencies in The Bahamas, educating them about Bahamian wildlife and why smuggling is such a threat to The Bahamas. He has led presentations and activities to help train Bahamian enforcers to identify terrestrial Bahamian animals that have been or have the potential to be smuggled out of The Bahamas.

In Trinidad and Tobago, CLiC Wildlife Trafficking group members Kareena Anderson, Laura Baboolal, and Sharleen Khan have been working towards the group's vision and goals. Recently, the team presented and held a

training session with the government in Trinidad and Tobago where the Trafficked Species Identification Guide was officially presented to Mr. Romano Macfarlane, who is the current Head of Wildlife Section in Trinidad and Tobago and who also has been very supportive of the project. The presentations included the issues faced due to wildlife trafficking and the issue of not being able to identify species.

The Caribbean is an amazing region, teeming with thousands of one-of-a-kind species. Our unique geographic histories, wildlife, and culture make this region one of the most exciting places on earth. However, as the demand for exotic animals continues to increase, our Caribbean wildlife faces an uncertain future. Many persons from around the world want to purchase wildlife products for fashion, pets, and novel foods. Some wealthy buyers even pay persons to act as "mules", using them to smuggle our wildlife out of the region. As Team Wildlife Trafficking, we believe in protecting our precious wildlife and are working with enforcement agencies to thwart the advances of wildlife smuggling in the Caribbean.

We have also created a Facebook page called CAWS Caribbean Against Wildlife Smuggling to help raise awareness about the dangers of smuggling and how it negatively affects wildlife in the Caribbean and around the world. You can like and [follow us on Facebook](#) for more information.

We are asking visitors — please do not purchase items such as coral, products made from turtle shells, feathers, or any exotic animal product, as you may be a conspirator helping to fuel the illegal wild animal market. Just enjoy the beauty of the animals in their natural habitat to ensure them for future generations. If everyone puts in a concerted effort to learn about wildlife and wildlife smuggling, our region will be one step closer towards eradicating this illegal activity once and for all.



Field Reports



A young female Aneгада Rock Iguana captured by a camera trap set in Windlass Bight in May 2017.

Anegada Rock Iguana (*Cyclura pinguis*)

Conservation, Applied Research, and Recovery of the Aneгада Rock Iguana, *Cyclura pinguis*

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

Overview. We requested funds to continue the Aneгада Iguana conservation program as it entered its 20th year. We proposed to build upon the progress made in previous years by (1) expanding investigations of iguana and flora interactions on Aneгада, (2) searching for and protecting nests in July, (3) releasing individuals from the headstart facility that are at least 20 cm in snout-to-vent length (SVL), (4) continuing camera trapping program to document the distribution, abundance, and habitat use of the wild/repatriated iguanas and invasive mammals on Aneгада, (5) hosting the 6th Annual Iguana Festival, (6) creating a video and purchasing equipment for a video graphic to be displayed inside the new visitor's center at the headstart facility, and (7) maintaining the field vehicle on Aneгада.

Hurricane Update. On 6 September 2017, the entire British Virgin Islands, including Aneгада, suffered catastrophic damage due to landfall of Hurricane Irma, a Category 5 storm. All communications were knocked out by the storm and Kelly Bradley was unable to receive any information concerning the status of facility staff, the captive animals on Aneгада, the conditions of the cages, or the headstart facility as a whole.

Three days later Michael Young, National National Parks Trust of the Virgin Islands (NPTVI)

staff member who works on Aneгада, was able to catch an emergency evacuation flight to Puerto Rico. Once Young had cellular service he called to report conditions at the facility. It was with great relief and gratitude that we learned no animals were lost in the storm and there was limited damage to the cages at the facility. Over the last three years, a trip has been made each year to refurbish/reinforce many of the older cages, plus install an entirely new enclosure system. It is clear given the intensity of this storm, that the money spent on facility maintenance and upgrades were worth every cent. We feared the worst, but experienced minimal loss of infrastructure and zero losses of animal life due in part to the generous support from the International Iguana Foundation.

The following outlines progress that was made during 2017 before the hurricanes.

Botanic Collaboration. We continued our collaboration with Kew botanists and the J.R. O'Neal Botanic Gardens in Tortola (JROBG) investigating iguana and flora interactions. Collaborators surveyed the island in February to identify patches of diverse forest that might support unknown iguana populations, and a location in the eastern Warner area was identified for future exploration. We also continued the seed germination study to determine if seeds passing through an iguana's gut enhances germination or growth. Seeds of *Amyris elemifer*, *Reynosia* sp., and *Ziziphus rignonii* were collected from wild iguana scat and planted at the JROBG. Further plant species would be collected during the October trip. Unfortunately, JROBG was completely destroyed by Hurricane Irma and this work has been put on hold until our partners



Kelly Bradley and botany team from the Royal Botanical Gardens, KEW, conducting surveys of rare plants at the east end of Aneгада in February.

in the BVI recover. Preliminary results did show promising differences in germination rate. These studies help expand the program's focus from a saving a single iguana species, to saving important mutualisms within the ecosystem. By camera trapping in areas with high densities of rare plant species, we could create a new method to identify previously unknown subpopulations and new locations for future iguana releases.

Nest Site Locating. Four nests in Windlass Bight and one in Bones Bight were located and fenced. Unfortunately, it is not likely we will be able to tell if these nests hatched post-hurricane.

Captive Facility Update. In July, the captive facility held 60 iguanas, with 25 that were slated for possible release in October. Two hurricanes within two weeks of each other, Irma and Maria, created an emergency situation for the captive animals. Two NPTVI staff remained on island and feeding the animals with what supplies they managed to procure. The Fort Worth Zoo team was able to have one shipment of produce delivered, and working on getting an emergency supply of pelleted diet to Anegada. However, Hurricane Maria also destroyed the staging area in Puerto Rico that was the best opportunity to get food to Anegada. Instructions were given to NPTVI staff



An iguana scat sample from Middle Cay that contained partially digested fruit from Reynosia sp. The seeds from this sample were sown at J.R. O'Neal Botanic Gardens in Tortola as part of the germination study.

to release all animals if they are unable to feed them. In this case, all 60 captive animals will be released, and K. Bradley will recapture as many animals as possible once she is allowed back on island. Large animals would be released to the core iguana area. Small animals could be put back in facility cages if conditions allow.

Camera Trapping. We set up a reconnaissance camera grid in the eastern Warner area in conjunction with the botanic collaboration (above). This area contains a healthy plant community, including numerous Black sage plants (*Veronia rupicola*). This is a Critically Endangered plant that appears to thrive in areas with iguanas. Unfortunately, the cameras collected no images of iguanas in this area between February and May 2017. Cameras were also set up in the core iguana area (Windlass Bight, Bones Bight, and Middle Cay) between May and July 2017 to continue the long-term monitoring of the released and wild animals. Finally, cameras were left observing each of the nests found in August 2017. Systematic camera grid surveys monitor strategic locations for long periods, gathering extensive data not previously collected. This noninvasive method has collected rarely observed behavior and other population structure data in the core iguana area, lending support for the protection of this area. If the storms have not damaged or moved the nesting cameras, K. Bradley will collect the images/data once she is allowed back on island.

Iguana Fest. Our annual education outreach event was scheduled to take place on October 20. This event has been delayed until a more appropriate time, and will likely be a much smaller event than originally planned. Residents look forward to the annual Iguana Fest — it highlights the island's uniqueness and encourages resident's ownership of the iguana program.



Natasha Harrigan, horticulturist at the J.R. O'Neal Botanic Gardens in Tortola, attending the seedlings from the iguana/seed germination study.

Visitor's Center Video. We collected video footage of wild adult iguanas during the May and July 2017 trips. The footage was submitted to the National Parks Trust in August. The NPTVI hired a local company to produce a short video that will be used as an educational graphic in the new visitor's center. When this project resumes we plan to purchase TV and video equipment for the center.

Future. Given hurricane Irma, the program's most pressing needs will be structural repairs at the facility. The NPTVI will also need equipment, materials, and miscellaneous supplies to continue their recovery from the storm. The FWZ and IIF will be in a good position to help our long-term partners rebuild so they can continue to support the iguana recovery program. Researchers will continue our collaboration with KEW on previous studies interrupted by the storm, but also investigate differences in how native plant communities in areas with and without iguanas recover. The 2017 Iguana Fest was to be greatly expanded with close to 150 children from other islands (Virgin Gorda and Tortola), plus the addition of local vendors selling handmade products and food/drink. It is our plan that the expanded event will be implemented in the 2018 Iguana Fest. We hope this will help create a sense of normalcy for the island's residents.



Fijian Iguanas (*Brachylophus* species)

Fijian Iguana Conservation through Development of a New Ranger Program for Macuata Island and Cross-training of Rangers on Monuriki and Yadua Taba Islands

IIF Grant Report submitted by Kim Lovich, Robert Fisher, Jone Niukula, and Nunia Thomas

Fijian Iguanas (*Brachylophus* species) currently exist in fragmented forest patches, that are isolated on remote islands. This relict distribution survives in areas where the land has little or no protection and is threatened by continued habitat loss and degradation, the spread of invasive species, and illegal collecting. This project aimed to create a community of rangers within Fiji that are tasked with protecting the endemic iguanas. Since the 1980s, there has been a Ranger Program on Yadua Taba Island protecting a population



Striking pattern of a Macuata Iguana detected during our post-cyclone surveys in March 2016. Photo by Robert Fisher.

of Fijian Crested Iguana, which has been successfully run by the National Trust of Fiji. With funding from the Disney Conservation Fund and the IIF, we expanded that program to include both Monuriki and Macuata Islands in 2016. As Macuata Island is privately owned, all access should be closely controlled, but historically it has not been. All three Rangers would receive the same training and tools for conducting their work. This would include deploying remote-triggered camera stations so that trespassing events can be quantified and categorized, potential poaching can be identified, and then interdiction can be optimized. Rangers would also be involved in educational outreach with school and village

programs, focusing on the protection of iguanas and the islands they occupy.

Our first discussion regarding hiring a ranger took place in August 2015 when Nunia Thomas (NatureFiji) identified Varayame ("Abraham") Tavualevu from Navunitogoloa Village as a potential candidate for Macuata Island. Abraham had previous experience working with the University of South Pacific when they first investigated the occurrence of iguanas on the island about ten years ago. He also helped put out the fire started by picnickers on the island in August. Discussion then took place with the island's owner about the possibility of having a ranger employed to oversee island activities. These discussions were positive enough to submit a proposal to IIF in December 2015 for funding this position.

In January 2016, Robert Fisher attended several meetings in Fiji to sort out logistics to support rangers for both Monuriki (funded by Disney) and Macuata (funded by IIF) Islands. With the National Trust of Fiji and NatureFiji, a supervisory infrastructure was developed to oversee the elements of this Ranger Program. In March 2016, the team met for the first time for initial education outreach and Ranger training. This week-long training included all three Rangers and several educators within Fiji and allowed everyone to develop a sense of the program. Part of the training took place on both Monuriki and Macuata Islands. The site visits focused on

the priority issues specific to each island, such as ecotourism on Monuriki, and illegal fires and trespassing on Macuata. Also during this trip, we conducted post-cyclone assessments, as Tropical Cyclone Winston affected both islands in February, just 5 weeks earlier. This was the second-largest cyclone to make landfall in the southern hemisphere and the eye passed right over Macuata Island. These assessments were critical to understanding how the iguanas fare after storm events. For the most part leaves were removed from the trees during the storm, and on Macuata many of the tops of the trees were missing. However, we found iguanas were doing extremely well on both islands, and there was a lot of new vegetative growth by our arrival.

As part of Ranger training in March 2016, we conducted surveys on Monuriki Island to see if we could detect any of the 32 captive-bred Crested Iguanas (*Brachylophus vitiensis*) that had been released in May 2015. We had previously conducted a short-term radio-telemetry project to show their survivorship over 56 days (Chand *et al.* 2016). During this survey, we were a bit concerned because the devastating cyclone was only five weeks prior to our visit. We conducted two nights of field work on Monuriki with the new Rangers and were unable to detect any of the captive-born and released iguanas. While this was quite surprising and concerning, we were able to find 15 wild-born iguanas, five of which were hatchlings. This was a huge number of individuals for this island, and we had never previously detected hatchlings (surveys in 1998 and 2003). It seems that this is an important response to the rat and goat eradication that took place in 2012. Overall, the wild iguanas are recovering at a fast rate and really show the success of the non-natives eradication effort. For comparison, we surveyed for Crested Iguanas on Macuata Island the following night and although we detected 21 iguanas none were hatchlings. Macuata Island still harbors many non-native rats and conducting an eradication is something the Ranger will help with in the future.

In June 2016, we continued training and the Rangers received their equipment and camera peripherals. We deployed cameras on the three islands and conducted training on photo downloading and processing. We programmed a special interface for the Rangers to use for data entry and analysis on their laptops. We collected preliminary datasets on this trip and helped the Rangers with processing them.

To date, this program is seeming to be very successful. When we arrive in Fiji in October 2016, we will revisit the camera setup and determine how well the process is working. No fires



Training Rangers on the use and attachment of the remote cameras. Photo by Kim Lovich.



Training Rangers on downloading and processing photos taken by remote cameras deployed on the islands to quantify and characterize trespassing. Photo by Robert Fisher.

have taken place on Macuata since we initiated the Ranger Program. Abraham was doing a great job of informing people about the rules for the island and taking his job very seriously.

Initiating this Ranger Program and education programs on Macuata and Monuriki Islands are building a lot of local excitement for iguana conservation. There has been an increased buy-in by the National Trust. Their only previous responsibility was for Yadua Taba, and taking on these additional islands puts pressure on their existing programs, but they see the short- and long-term benefits of this expanded iguana conservation network. Additionally, Rangers from Sigatoka Sand Dunes and other sites are helping to form the education and training programs, and serve as peer groups for the new iguana Rangers. Having the Rangers named and identified locally has given a sense of conservation to these two islands that was lacking before. Having a responsible party that everyone looks to really makes a difference. With the camera imagery, we will be able to start quantifying access on these islands, and can really focus on the groups that are out of compliance.

Unfortunately, Abraham disappeared on August 31 while fishing not far from Macuata Island and we will be presenting something to his family following the IUCN ISG Meeting in Fiji. This was quite a surprise, and everyone is very upset about these circumstances. We are working to identify another potential Ranger to continue the work and start their training. The village and the island's owner are both very enthusiastic about the Ranger Program and we plan to continue it long-term and work towards its sustainability.

References:

Chand, R., J. Niukula, J. Vadada, R. Fisher, K. Lovich, S. Pasachnik, S. Rasalato, B. Thaman, E. Seniloli, T. Tuamoto, T. Yanuya, and P. Harlow. 2016. Captive breeding and re-introduction of the Monuriki Island Crested Iguana in Fiji. Pp. 76-81 In: Global Re-introduction Perspectives: 2016. Case Studies from Around the Globe. P.S. Soorae, ed. Gland, Switzerland: IUCN SSC Re-introduction Specialist Group and Abu Dhabi, UAE: Environment Agency-Abu Dhabi.



Mona Rhinoceros Iguana (*Cyclura stejnegeri*)

Restoring Nesting Sites for the Mona Island Iguana through the Removal of the Invasive Australian Pine

IIF Grant Report submitted by Cielo E. Figuerola, Robert J. Mayer, Iván Llerandi, Idelfonso Ruiz and José L. Herrera. *Photos by Island Conservation.*

In May 2017, we headed to Mona Island to begin the implementation of a project focused on restoring nesting sites for the endangered and endemic Mona Island Rock Iguana by removing the invasive Australian Pine (*Casuarina equisetifolia*). This project is being developed by the U.S. Fish and Wildlife Service through the Coastal Program, the Department of Natural and Environmental Resources of Puerto Rico (PR-DNER), and Island Conservation, with the support of the local non-government organization Vida Marina. Australian pines were introduced to Mona in the



All logged pine material was removed from the site, with larger timbers used to repair island infrastructure.



After the trees were cut down, all remaining pine needles were raked from the site to expose nesting soil.

1930s so their wood could be harvested and used for various purposes, as utility poles, for example. However, transporting the wood off the island was very expensive and logistically challenging. As the years went by, profits decreased and markets changed, and the pine plantation was abandoned. Unfortunately, the plantation was established on prime nesting habitat for the Mona Iguana, making nesting very difficult.

Invasive Australian Pines have harmful impacts on Mona's ecosystem in many ways. Through the release of certain compounds, they change the chemistry of the soil and preventing growth of native vegetation. They can cause beach erosion in coastal habitats and can decrease plant biodiversity, just to name a few of their impacts. For iguanas specifically, when pine needles fall and cover the ground, they form an almost uniform carpet of invasive plant matter in the understory, occluding the sandy substrate iguanas need to excavate to build their nests. The

pine needle carpet prevents them from nesting in these areas. Another problem is the constant shade produced by the pines — iguanas need to build their nests in areas with sun exposure and in the shady pine forest this is not possible. These pine impacts combined with the ongoing invasive vertebrate species impacts (like egg and hatchling predation by feral pigs and cats) put Mona Iguanas at risk, especially during their most vulnerable life stages. Our main goal with this project is to cut down the pines, remove the pine needle carpet, and then place trail cameras in the restored sites to document iguanas using these newly restored and habitable areas to nest in future nesting seasons. We're hoping that the wood from these trees can be repurposed to repair infrastructure on the island. Vida Marina has vast expertise in Australian Pine felling through their coastal restoration efforts in the northern region of Puerto Rico.



An aerial view of the test plots before (left) and after (right) invasive Australian Pine removal.

Despite some challenges, we have been able to conduct three successful field trips and we have met our goals for each trip. So far the team has removed 36 pine trees and over 270 kg of pine needles and debris in 15 days of work. Six new nesting areas for iguanas have been created, which translates into 1.08 km² of ideal habitat for nests. The best reward for our efforts is seeing that iguanas are already nesting in the restored plots! We documented three nest attempts and three nests in-progress in an area that, prior to pine removal efforts, had five pine trees growing and a pine needle carpet five inches deep. Over the past five years, we have been conducting nest surveys and we had never seen a single nest in this area. Unfortunately, after these observations Mona Island received the impact from Hurricane Maria and our follow-up visits were paused. We know the island did not suffer from the winds but it did from the rain. We hope to go back to Mona in the upcoming weeks and assess how the nesting areas have been impacted by the hurricane and how that impact translated into the hatching season. On a positive note, so far our efforts have directly translated into the results we were hoping for, and almost immediately. These results clearly show how important and needed these new nesting sites are for iguanas on the island and how important it is to manage the threats caused by invasive species appropriately.



Mona Rhinoceros Iguanas began to nest in the plots almost immediately after pine removal.



Christopher Pellecchia with a large female Rhinoceros Iguana, *Cyclura cornuta*. Photo by Jerbin Volquez.

Ricord's Rock Iguana (*C. ricordii*) and Rhinoceros Iguana (*C. cornuta*)

Interspecific Interactions, Ecology, and Conservation of *Cyclura cornuta* and *Cyclura ricordii* south of Lago Enriquillo

IIF Grant Report submitted by Christopher M. Pellecchia, Stesha A. Pasashnik (Fort Worth Zoo), and Carl P. Qualls, University of Southern Mississippi

Overview. The Dominican Republic features a unique ecological phenomenon within the genus *Cyclura*: the sympatry of two species of rock iguanas: the Critically Endangered Ricord's Rock Iguana (*C. ricordii*) and the Vulnerable Rhinoceros Iguana, (*C. cornuta*). Grupo Jaragua (GJ) and the International Iguana Foundation (IIF) have made immense conservation strides for both species in the Pedernales region of the Dominican Republic, as well as monitoring of iguanas south of Lago Enriquillo since the 2002 Ricord's Species Recovery Plan. However, in the area south of Lago Enriquillo, both species face intense threats of habitat loss and degradation due to the illegal charcoal industry, agriculture, poaching, and invasive species.

For the 2017 field season, we investigated the distribution, population demographics, and burrow ecology of both species of *Cyclura* south of Lago Enriquillo. We also searched for critical nesting habitat locations and examined the roles in which geological features, such as canyons, may impact the ecology of both species. We used camera traps, a burrow camera system, and live-traps

to survey across the region from 18 June to 14 August 2017.

The field team consisted of Christopher Pellecchia from the University of Southern Mississippi, Stesha A. Pasachnik, Ph.D. from Fort Worth Zoo, and M. Anibal Volquez, Jerbin Volquez, and Winston Volquez from Grupo Jaragua.

Population Demographics and Morphometrics.

We deployed 24 live-traps across 17 locations during our field season. We captured a total of 104 *C. ricordii* and 23 *C. cornuta*. We implanted PIT tags in 101 *C. ricordii* and all 23 *C. cornuta*. We also recaptured a lone juvenile *C. ricordii* which received a PIT tag during a 2016 trip to the region. With so many iguanas now PIT-tagged, the opportunity for detailed long-term population monitoring using mark-recapture methods is possible. Upon capture, iguanas were measured, weighed, marked, and PIT-tagged. We also took tissue samples from each individual, which will later be used for genetic analysis. Detailed photos were taken of each individual iguana, which we hope to integrate in a digital morphometric analysis at a later date.



A subadult *Cyclura ricordii* captured by a camera trap placed on a rock outcrop. Photo by Christopher Pellecchia.



Above: A young male *Cyclura ricordii* that was measured, weighed, marked, PIT-tagged, and released. Below: A gravid female *Cyclura cornuta* which was captured, processed, marked, and released. Photos by Christopher Pellecchia.



Species Distribution and Habitat Modelling. We used eight Bushnell Trophy camera traps in 18 locations during our field season, to determine iguana presence or absence across a variety of habitats. These camera traps also recorded daily activity patterns of both species of iguana, as well as invasive species such as feral cats, and the Endangered endemic Hispaniolan Solenodon, *Solenodon paradoxus*. We also collected data on dominant plant species, substrate type, canopy cover, ground cover, anthropogenic impacts, signs of invasive species at burrow locations, iguana sightings, and where iguanas were captured. These data will be used as parameters in a resource selection model to determine habitat and resource availability and preference for both species.

Burrow Ecology. The team examined 92 iguana burrows at 13 sites with a custom burrow scoping system. We found iguanas in 27 of those burrows, confirming *C. ricordii* presence in 24 burrows and *C. cornuta* presence in three burrows. We also found one invasive amphibian species and a minimum of seven commensal species including various insects, arachnids, and small reptiles using the *Cyclura* burrows. We believe this minimally-invasive survey method could be helpful in other studies of *Cyclura*. We observed individual iguanas using multiple burrows and multiple iguanas using a single burrow. Surprisingly, we also observed *C. cornuta* and *C. ricordii* using the same retreat burrow. Our camera traps monitored iguana activity

around a single burrow, and we observed long periods of daily iguana presence followed by daily periods of absence. This may suggest that iguanas are regularly using more than one burrow within their territory, which may alter previously used population estimation methods where a single burrow is counted as one iguana.

Nesting Habitat and Nesting Ecology. The team found five *Cyclura* nests at four sites. We suspect three of these were *Cyclura ricordii* nests and two were *Cyclura cornuta* based on stage of development, nest location, and timing within the breeding seasons of each species.

Charcoal Industry and Poaching. The illegal charcoal production industry south of Lago Enriquillo created an immense obstacle for the field team this season, and is considered one of the greatest threats to *Cyclura* in the Dominican Republic. The epicenter of this industry occurs in our focal region. We discovered actively burning charcoal kilns, 'carboneros' (illegal charcoal workers), and illegal mines within 100 meters of our study sites. The carboneros not only pose a threat to iguana's habitat, but often these individuals are also 'iguaneros' (illegal iguana poachers) who harvest iguanas as they clear-cut the land. Iguanas are sold for consumption or less frequently for the illegal pet trade. We identified five major active charcoal operations near our study sites. We also discovered and removed many illegal snare traps placed at *Cyclura* burrow entrances within our study sites. At one charcoal camp, we discovered the remains of at least nine iguanas (both *C. cornuta* and *C. ricordii*), presumably eaten by the carboneros. We reported all active charcoal operations to the Ministry of Environment and Natural Resources (Medio Ambiente RD) through Grupo Jaragua.

Future. We will continue with our 2017 field season methods during the summer of 2018. We will expand our surveys, trapping, camera trapping, and burrow scoping to cover the western portion of the area south of the lake. We also aim

to expand our knowledge of *Cyclura* burrow use, densities, and abundance. Any information regarding *Cyclura* burrow use in the Dominican Republic could be applicable to other *Cyclura* species. We hope to begin an iguana mark-recapture program which will require revisiting our 2017 sites annually. This could yield valuable data on population dynamics, community ecology, and the impacts of poaching for each species. We plan to continue our habitat data collection and use fresh aerial imagery (satellite, aircraft, and/or drone) to refine our resource selection model, burrow ecology study, and charcoal monitoring effort. Lastly, we hope to conduct fine scale genetic analyses of both species within the region. We will request funding from the International Iguana Foundation in 2018 to continue these efforts.



Roatán Spiny-tailed Iguana (*Ctenosaura oedirhina*)

Monitoring the Roatán Spiny-tailed Iguana and Cultivating the Next Generation of Researchers and Managers - 2017

IIF Grant Report submitted by Ashley Goode and Stesha Pasachnik

In order to create a sustainable monitoring program, as well as foster the next generation of iguana researchers and managers, we offer a ten-day workshop in which local students and interested members of government/NGOs obtain intensive training in the field and participate in various education activities (Objective 1), while collecting vital natural history data (Objective 2). Workshop participants gain experience in all the basic techniques of iguana research including: iguana capture and processing, blood collection, data entry, and basic data analysis. These skills are learned through a combination of lecture and hands-on experiences, catered to the participants' specific needs and interests. Participants are also able to gain experience writing IUCN Red List assessments, working as a team to analyze and document the iguana's diet, conducting flight distance and behavioral trials, using transect surveys, and collaborating with local organizations (e.g., Kanahau Útila Research and Conservation Facility). The data collected during these workshops is continually added to the life table for this species to inform management strategies. This is the first long-term demographic study for the *Ctenosaura* genus.



Christopher Pellecchia standing behind a freshly assembled charcoal kiln found near the shores of Lago Enriquillo. Photo by Jerbin Volquez.



A participant marks their first *Ctenosaura oedirhina* during the workshop. Photo by Ashley Goode.

We held two ten-day workshops in August 2016 and March 2017 on Roatán, an island off the northern coast of Honduras.

Objective 1 - Workshops. In August 2016, three people from Guatemala and Honduras participated. Two of the participants are university undergraduate students and one is the species program manager for Zootropic in Guatemala. In March 2017, three people from Honduras, Guatemala, and St. Eustatius participated, with all their costs covered. One participant is a university undergraduate student, one is the director of a Honduran herpetological organization, and one is a park ranger for St. Eustatius National Park. In addition, we had a Roatán local and an individual from the UK (working on the Útila Spiny-tailed Iguana) participate in parts of the workshop.

After assessing the background and interests of the participants, we designed the field and lecture components of the workshop to cater to them. In addition to basic iguana capture and processing, participants left having practiced blood drawing, distance sampling, behavioral ethograms, flight distance surveys, re-sighting surveys, data collection, and project planning. Each participant in August also contributed to writing an IUCN Red List update (*Ctenosaura bakeri* and *Ctenosaura palearis*), thus they will be co-authors on these publications. We also began a dietary study by creating a catalogue of local flora, and collecting and sorting scat samples from the iguanas. The floral catalogue includes plant species that were blooming or fruiting during the two workshops. These scat data will eventually be used in a short communication on diet, and all participants will be co-authors.

We believe that by training participants we help to build capacity in the region, for those just beginning their research careers and those already involved in iguana projects. For the two students who participated in August 2016,

this workshop exposed them to the necessary components of field research, becoming familiar with important data collection techniques. In one participant's post-workshop survey he said, "...I came here without any experience or particular interest in iguanas, and I leave with a lot of knowledge (on iguanas and general stuff) and I'm actually interested in continuing working/researching about this group." The species program manager participant gained ideas for additional research that could be incorporated into her programs, and access to experts in the field with whom she can continually reach out to for advice.

Participants in general gained a better understanding of threats to iguanas and of the technology available to track and monitor them. In order to assess the success of the workshop we used pre- and post-workshop surveys. One



Two participants retrieve fresh palm seed samples for the diet study. Photo by Ashley Goode.

participant remarked in their post-workshop survey, "I really enjoyed the fact that we got to do most of the stuff we were learning through the presentations." Another said, "...the lectures showed application of things I know 'on paper' but hadn't really seen."

One of the participants from the March 2017 workshop is now interested in working on a project focusing on the Southern Honduran Spiny-tailed Iguana (*Ctenosaura praeocularis*) with a student from our August 2016 workshop. The park ranger from St. Eustatius, from our March workshop, left with new ideas on how to better monitor and protect the Lesser Antillean Iguana (*Iguana delicatissima*), including parasite screening. The undergraduate student from March left with plenty of capture and tagging practice so that he will have a very productive season on his project with the Motagua Spiny-tailed Iguana (*Ctenosaura palearis*).

Objective 2 - Monitoring. Natural history data was collected for the 6th and 7th year. Mark/recapture surveys were conducted at five of our study sites. Distance sampling surveys continued along previously-defined line transects. In August 2016, 99 new iguanas were captured and tagged and 20 iguanas were recaptured by workshop participants, adding to the growth and survival data for this species. Two of the recaptured



Two participants work together to measure and tag a *Ctenosaura oedirhina* while Ashley Goode records the data. Photo by Stesha Pasachnik.

iguanas were from 2010, three from 2011, and most were from 2013-2015.

Analysis of the data from 2016 may not indicate actual population changes because it was collected in the week following Tropical Storm Earl. Severe weather does not often impact Roatán due to its location, however, because there was multiple days of rain and heavy cloud cover, iguanas were not as visible as they usually are during this time of the year. Density estimates from this season indicate a decrease from the previous year by ~34%, while encounter rate remained unchanged. Again, this is not likely an



Ctenosaura oedirhina #57, a recapture in March that was first captured and tagged in 2010. Photo by Ashley Goode.



The smallest *Ctenosaura oedirhina* captured during the workshops, a 10g hatchling. Photo by Ashley Goode.

actual decrease, but an artifact of the post-storm collection bias.

Over the course of this study from 2010 onward, we have demonstrated an overall decline in this species. Thus, continued monitoring of demographic trends is vital to proper management of this species. In addition, maintaining a presence on the island helps to reinforce the protection of the iguanas, especially at study sites where hunting intrusion occurs. The population has been monitored using mark/recapture techniques for seven years, while distance sampling data has been collected for six years now.

While 2016's distance sampling data may be an outlier because of Tropical Storm Earl, these data allow us to assess the effect of such events over time. The 20 recaptured and 99 newly-tagged iguanas provide important data points for growth, coloration, and survival analysis. Recaptured individuals during the last workshop show that some of the originally captured iguanas from 2010 are still surviving. These demographic data provide the first long-term monitoring effort for this genus and can thus be used as a model for other species within the genus.

Future Plans. We will continue these workshops to ensure that monitoring of this species

persists, while building capacity in iguana range countries. In future years, we would like to include additional smaller projects, similar to the dietary study. This will allow participants to experience managing data collection, analyzing data, and give them the opportunity to publish short articles.



Sister Islands Rock Iguana (*Cyclura nubila caymanensis*)

Population Trends and Age-dependent Survivorship in *Cyclura nubila caymanensis* on Little Cayman: An Ongoing Study in Conservation Biology

IIF Grant Report submitted by Jeanette Moss, Mark Welch (Mississippi State University), and Glenn Gerber (San Diego Zoo Global)

Overview. The first major objective of this project was to assess trends in Little Cayman's breeding population of Sister Islands Rock Iguana (SIRI) in light of a third consecutive year of nest counts and Capture-Mark-Release-Recapture (CMRR) data. We maintained regular surveys of eight known nesting sites on the West End, accounting for shifts or declines in nest densities as well as return rates of tagged females. Intensive island-wide sampling was carried out to monitor turnover in the adult population.

In addition to evaluating trends in the adult population of Little Cayman, another major objective of this study was to investigate recruitment and age-dependent survivorship. By



A large male Sisters Island Rock Iguana on the East End of Little Cayman. Photo by Hanne-Marie Christensen.



Jen Moss and volunteers, Graham Gorgas and Kevin Moore, process a female rock iguana. Photo by Giuliano Colosimo.

nearly doubling our hatchling sampling efforts between 2015 and 2016, and expanding our regular survey areas in 2017, we anticipated greater precision in our estimate of initial cohort size, which should illuminate reproductive success in the population.

Finally, a major objective of this summer was to apply research methodologies developed on Little Cayman to identify possible nesting areas on Cayman Brac and evaluate hatching success and inbreeding load. To achieve this goal, we organized a preliminary three-week trip to Cayman Brac at the peak of nesting season to identify nests, which will be sampled for hatchlings later in the season.

Resolve Population Trends on Little Cayman.

From May through June 2017, we conducted daily surveys of major nest sites on the West End of Little Cayman to note fresh activity and maintain records of any marked or unmarked females encountered at the communal nesting aggregations. These eight sites, one originally identified by Glenn Gerber in 1992 (Preston Bay) and seven additional sites identified by Matt Goetz in 2010, have been surveyed continuously since 2015 to assess current trends in population recruitment and habitat use. In addition, we expanded our regular survey extent to include three new sites along the southern coastline. This ground-work will facilitate our goal of radio-tracking

hatchlings from a wide distribution of the island during emergence season in August.

Although 2017 can be characterized as a particularly wet summer, final nest counts reflect overall stability at most sites over the last three years. However, we have noted a marked decline in reproductive effort at the island's largest communal nesting site, Preston Bay. This site was estimated to have supported over 60 nesters in 2010 and 25 in 2015, but contained fewer than 15 nests by our final tally in 2017. Our CMRR data obtained on our daily roadside transects, also suggest a steady decline in the adult breeding population. Of 208 adults tagged over the last two summers, only 85 individuals remained unaccounted for by the end of our intensive surveys in 2017. However, at least 17% of individuals "lost" between 2016 and 2017 can be positively traced to road mortality, and less than 25% of the nearly 180 iguanas marked by Goetz between 2007 and 2011 have ever been recaptured. Taken together, these data suggest that longevity may be more limiting in this population than originally presumed, and that despite the appearance of robust densities, attrition in the adult breeding population may be a driving gradual population reduction.

Evaluate Population Recruitment. Population surveys in 2017 followed intensive sampling of neonates in August 2016, yielding over 420 tagged hatchlings. Under the assumptions of the Lincoln-Peterson model including equal catchability of marked and unmarked animals, our



Giuliano Colosimo poses with team's largest capture of the season, a 1.3 meter, 11 kilo male SIRE. Photo by Jen Moss.



A female SIRE rests on top of her nest at a large communal site on Cayman Brac. Photo by Jen Moss.

maximum likelihood estimate (MLE) of recapture probability for the 2016 cohort was 11%, generating an initial cohort size of 3,722. Provided SIRE's large average clutch size and high hatching success, fewer than 300 breeding females could have produced a cohort of this size. Although the 95% confidence intervals around this estimate are very large — approximately 2,000 to 21,000 — we suspect annual reproductive output is quite robust on Little Cayman.

Although the behavioral ecology of adult rock iguanas is relatively well studied, our current understanding of juvenile ecology is limited. By intensively sampling neonates between the 2015 and 2016 hatching seasons, then recapturing yearlings the following season, we have started to shed some light on this critical life stage. Results thus far indicate high reproductive success and overall high dispersal among neonates, further upholding the major focus of SIRE management planning — nest site protection — for maintaining healthy densities of iguanas across Little Cayman.

Identify Active Nesting Sites on Cayman Brac. Identifying active nesting sites on Cayman Brac

represents an important first step in outlining conservation priorities for this reduced sister population. Before starting, no communal nesting sites were confirmed to remain on Cayman Brac due to intense development pressures. We spent three weeks on the island surveying for nesting sites and tagging adult iguanas. We were pleasantly surprised to observe high traffic by nesters along a large stretch of southern coastline, as well as patchy digging in a community park area. By the end of the period, we captured nearly 50 iguanas. Because Cayman Brac supports a large human population, it is important to communicate the vital role these areas serve for iguanas and to discourage development.

Having marked and excavated a number of nests, we anticipate high success at sampling hatchlings in August, as we have done successfully on Little Cayman for the past two summers. Additionally, the majority of our captures on Cayman Brac were new captures, despite tagging efforts that have been ongoing for the past five years. This suggests that the Cayman Brac SIRE population, which is presumed to have declined significantly in recent years, is reproducing successfully and may in fact be rebounding by

some margins. We intend to evaluate our collected samples for any genetic sign of inbreeding depression in this population.

Future. Over 300 adults and nearly 900 hatchling SIRI have been tagged on Little Cayman since 2015. Additionally, we anticipate at least 100 adults harboring tags will survive on Cayman Brac, and hatchlings were marked for the first time this month. In order to maximally capitalize on these years of effort, we propose making at least one annual return trip to the islands over the next two to three years. A short (2-3 week) sampling and surveying trip around the peak of nesting would allow us to address questions of nest-site fidelity by females and hatchlings and to uphold ongoing mark-recapture efforts, both of which would be valuable to our understanding of population ecology. Continuing to expand research efforts onto Cayman Brac would also be advantageous for informing conservation management across the range of SIRI. Finally, addressing the upsurge of invasive Common Green Iguanas (*Iguana iguana*) and hybrids in the Sister Islands over the last three years has become a conservation priority, demanding regular research and monitoring. Our hope is to continue to cultivate and expand our partnerships with the Cayman Islands Department of Environment and the National Trust to better manage these emerging threats.

In addition to SIRI nesting activity, the summer of 2017 has been an eventful season for invasive Common Green Iguanas on Little Cayman. Following the discovery of hybrids on Little Cayman in August 2016, our team has taken steps to strengthen our collaborative relations with the local NGO, "Green Iguana B'Gonna," co-founded by Mike Vallee and Ed Houlcroft of the Little Cayman National Trust. Over the nine weeks we spent on Little Cayman, with the support of IIF funding and the Department of Environment, this partnership resulted in the capture of two Green Iguanas that had just made landfall at Salt Rock Dock, narrowly thwarting their establishment on the island. In addition, thanks to dedicated reporting by the local community we managed to recover two more hybrids, presumed to be members of the original 2016 clutch. Reports indicate that at least two more individuals may be at large and their reproductive potential remains unknown. Unfortunately, the tremendous effort and fortitude that ultimately led to this handful of captures underscores the great challenge that an island like Little Cayman has to face in its struggle against Green Iguanas. Because so much of the island remains undeveloped and the



The team poses with the latest hybrid capture, apprehended with the help of diligent reporting by the community. Photo by Jen Moss.

human population is fewer than 200, recovery rates for individual Green Iguanas, even following reliable reporting and rapid response, are exceptionally low. Despite their low densities, neighboring Grand Cayman clearly exemplifies how Green Iguanas could pose a major threat to the island and its native rock iguanas should they achieve breeding numbers and become established. Alarmingly, just in the last couple of weeks our team recorded the first incidence of neonate Green Iguanas presumed to have hatched on Little Cayman (at Preston Bay, a protected SIRI nesting site) since Mike Vallee recovered the better part of a clutch in 2012. These incidents, taken together, demonstrate the severity of the threat Green Iguanas can become on an otherwise pristine island like Little Cayman if gone unchecked. Our hope is that through continued community involvement, significant volunteer effort, and the support of government and international bodies, the Sister Islands can serve as a model for putting effective Green Iguana biosecurity measures into action.





Ctenosaura bakeri in mangrove habitat. Photo by Thijs Van Den Burg.

Utila Spiny-tailed Iguana (*Ctenosaura bakeri*)

Population, Hybridization and Nesting Ecology of the Critically Endangered Útila Spiny-tailed Iguana *Ctenosaura bakeri* on the Island of Útila, Honduras.

IIF Grant Report submitted by Daisy Maryon and David Lee, University of South Wales

This project investigates the population size, habitat preference, and nesting ecology of *Ctenosaura bakeri*, and its current rate of hybridization with *Ctenosaura similis*. There is an urgent need to update our previous studies in light of increased habitat degradation, fragmentation and loss, and poaching of iguanas.

Population Size and Demography Data in the Western Side of Útila. Continuing from fieldwork in 2016, we established two new sites on the island for population monitoring. This was possible with boat transportation funds provided by the IIF, since we were now able to access the western and interior areas of Útila with greater ease. Nine sites were surveyed across the island in 2016 and 2017, totaling 28 transects from 50-500 meters long. To date in 2017, we have 238 *Ctenosaura bakeri* sightings along transects — this data will enable us to provide a more accurate estimate of population size and demography. Our population estimate will incorporate natural variation based on habitat type (see below) and location access, as a potential surrogate for hunting pressure.

Since 2016, we have collected biometric data on 181 *Ctenosaura bakeri*, and were able to determine 69 of those were female and 74 were male. The longest iguana found was a male with

a 30.3 cm snout-to-vent length, a tail length of 42 cm, and a weight of 800 grams. The biggest mass found was also a male at 867 grams. The largest female found was 357 grams with a snout-to-vent length of 22.5 cm and tail length of 25.8 cm. Of the females caught in 2016-2017, 55% had regrown tails, while tail regrowth occurred in 31% of the males caught during the same period.

Habitat Data Collection. We set up transect lines at 50 meter intervals to collect data on habitat structure. Our transects comprised almost all habitat types on Útila and will be used to ground-truth satellite imagery in the second half of this project. During our transect surveys, iguanas were found most often in mangrove habitats. A habitat classification analysis has been generated for Útila using the July 2015 LANDSAT 8 satellite, which enabled us to look at the extent of habitat availability on Útila for *Ctenosaura bakeri*. In 2015, the extent of mangrove habitat (their preferred habitat) was 8.4 km². The extent of mangrove within Útila's only protected area, Turtle Harbor Wildlife Refuge, appears to be 1.47



Male and female *Ctenosaura bakeri* in branches of black mangrove. Photo by Thijs Van Den Burg.



Kanahau Team and Útila beach cleanup volunteers cleaning up a nesting beach of *Ctenosaura bakeri* on the western side of Útila. Photo by Siel Wellens.

km², meaning only ~17.5% of preferred iguana habitat is currently protected. We will combine the satellite data from the last 15 years with ground-truthed habitat data to gather information on how these areas have changed and how much habitat may have been lost.

The Turtle Harbor Wildlife Refuge appears to be a prime area for hunting both iguana and sea turtles; remains of each were found and hunters caught on camera traps. It is our opinion that this nature reserve should be expanded, or a new nature reserve proposed, and that adequate protection is provided for mangroves.

Genetic Analysis. Habitat degradation has changed the degree to which the two iguana species are in contact with each other. This year we collected new samples from 35 *Ctenosaura bakeri* and 25 *Ctenosaura similis*. We aim to investigate the current rate of hybridization between the two species and determine what effect this may have on the *Ctenosaura bakeri* population. Data collection is continuing until late September and genetic analysis will be conducted in our United Kingdom lab starting October 2017.

Hatchling and Nesting Ecology. Hatchlings have been recorded from February through August so far. The earliest sighting was on 21 February 2017 and the first hatchlings caught and processed were on 21 April 2017. February is a much earlier period for hatchlings than previously thought and this may indicate an extension to the breeding season. Hatchlings were spotted along transects in a range of habitats including sandy beaches, piles of trash, and white, black, and red mangrove. We had one nest viewable with a camera trap. Although this nest was shallow, and we filmed raccoons, cows, feral dogs, and cats walking over the nest, in July it had 100% hatching success from 10 eggs.

Community Outreach and Environmental Awareness. This project has supported an education program run at five schools on Útila with the Kanahau Útila Research and Conservation Facility (KURCF), the Bay Island Conservation Association, and the Whale Shark and Oceanic Research Centre. The program features lectures on *Ctenosaura bakeri* and their habitats. For the adult Útilan, expat, and tourist communities, we conducted small awareness surveys, citizen science monitoring surveys in the mangroves, and hosted beach clean-ups to expand local knowledge about the species and increase awareness about its conservation. In April 2017, Daisy Maryon and KURCF staff members met with the Instituto de Conservación Forestal (ICF), the Honduran

protected areas agency, in Tegucigalpa and gave a presentation about the threats to *Ctenosaura bakeri* and our research program. This has led to a good working relationship with ICF, and hopefully a good partnership going forward into the future.

Capacity Building and Tools. Thanks to the IIF grant, this year we were able to train and pay a field guide, Nahun Molina, to accompany us on population and habitat surveys. This is a small, but vital first step in providing an alternative livelihood to hunting iguanas on Útila. Nahun no longer hunts iguanas on Útila but lives in the community where hunting is common.

The camera traps have been useful in multiple ways. Unexpectedly, they have provided interesting insights into the periods that hunters use particular areas for hunting. We have also accumulated spatial data from them by identifying where *Ctenosaura bakeri* and *Ctenosaura similis* coexist naturally and the diurnal activity patterns of iguanas in these areas. All over the island, we've gathered data on where potential predators occur. Invasive raccoons have been caught on camera traps within the protected Turtle Harbor Wildlife Refuge and coming into contact with iguana nests.

Future. We intend to continue to monitoring the population and collecting genetic samples, together with Kanahau Útila Research and Conservation Facility. We would like to further explore the interior and western sides of Útila and try to identify an area that could be proposed as a new nature reserve. We also plan to investigate the nesting season in further detail to determine whether *Ctenosaura bakeri* has a longer, or possibly two, nesting seasons and what parameters may be driving this. We also think it is essential to expand community involvement and awareness about these iguanas, and if possible hire a second guide.

Yellow-backed Spiny-tailed Iguana (*Ctenosaura flavidorsalis*) and Five-keeled Spiny-tailed Iguana (*Ctenosaura quinquecarinata*)

Evaluation of the Genetic Diversity of the Yellow-backed Spiny-tailed Iguana (*Ctenosaura flavidorsalis*) and Five-keeled Spiny-tailed Iguana (*Ctenosaura quinquecarinata*), Sister Taxa to the Threatened Oaxacan Spiny-tailed Iguana

IIF Grant Report submitted by Gabriela Díaz-Juárez and Víctor Hugo Reynoso, Universidad Nacional Autónoma de México (UNAM)

Introduction. This project is Part Two of our IIF-supported grant “Effects of habitat fragmentation and hunting on the genetic diversity of the threatened Oaxacan Spiny-tailed Iguana” (see previous report). Here, we extended sample collection to their sister taxa, *Ctenosaura flavidorsalis* and *Ctenosaura quinquecarinata* with the main goal overall to establish genetic parameters of the three sister species’ populations by using molecular techniques. During the field work, we aimed to collect 30 samples from each of *C. oaxacana*’s sister species throughout their distribution area. Among the main expected results, we aimed to establish the genetic diversity, genetic structure, and effective population size of the three species. These results will provide essential information to develop management plans for their conservation and to re-evaluate their status within the IUCN Red List of Threatened Species.

Outcomes. We obtained field data and blood tissue samples from 120 individuals of the



Ctenosaura flavidorsalis. Photo by Víctor H. Reynoso.



Field Guide Nahun Molina with a young female *Ctenosaura bakeri*. Photo by Daisy Maryon.

Summary Highlights

- Deployed camera traps at two sites to monitor iguana interactions and nesting behaviors
- Recorded the presence of nests and hatchlings, and habitats at both sites with camera traps
- Determined the sex ratio of hatchlings to establish whether our observed adult sex ratio (fewer females) is present at hatch or develops post-hatching
- Created 28 distance-sampling line transects to provide an updated estimate of population size
- Collected biometric data for 181 captured and tagged iguanas to assess body condition and health of the population
- Collected habitat data from 119 plots across the island





Ctenosaura quinquecarinata. Photo by Gabriela Díaz-Juárez.

Yellow-backed Spiny-tailed Iguana (*C. flavidorsalis*). Thirty samples were collected from El Salvador (La Cueva de Corinto, Morazán), 30 from Honduras (south of La Paz), and 60 from Guatemala (30 each from SE and NW Rincón, Jutiapa). We also collected 90 samples from the Five-keeled Spiny-tailed Iguana (*C. quinquecarinata*) from Nicaragua (Boaco, La Cruz, and San Francisco del Norte; 30 iguanas per locality).

Capture of *C. flavidorsalis* began on 14 May 2016 in the town of Rincón Jutiapa within the Department of Jutiapa (Guatemala). The habits of the species are similar to those reported for other species in the quinquecarinata complex. They were usually found living within tree trunk hollows, although sometimes they were captured within piles of volcanic rocks or sometimes in the cracks. Hasbun *et al.* (2005) considered the locality SE of Rincón Jutiapa as different from NW of Rincón Jutiapa. However, to our surprise, these localities were very close to one another (less than 1 km) and for purposes of our study we considered them to be the same. Within this zone, 28 iguanas were captured: 10 females, 16 males and two hatchlings. The surrounding habitat is very fragmented with very small remnants of dry forest within farming land. The iguanas

were captured close to the hills, and sometimes within the areas of crops. We did not find iguanas in the plains.

In El Salvador, capturing iguanas was very challenging; the preferred habitat of *C. flavidorsalis* was substantially different to what we were expecting. The site was quite high in elevation, located just before the transition of dry forest to pine forest and iguanas preferred to use cracks of large volcanic rocks for refuges. The large size and weight of these rocks did not allow for easy search and capture of iguanas. However, in the Cueva de Corinto locality (Department of Morazan) we managed to capture 26 iguanas: six females, eight males, and 12 tail tissue samples (the iguana itself was not captured, just the tail). In La Paz (Department of La Paz, Honduras) we captured iguanas in tree holes, fences made from volcanic rock piles, and wooden pole fences. Here we captured 28 iguanas: 10 females, 14 males, and four hatchlings. In this zone, the habitat is fragmented principally by some urbanization and agriculture and cattle ranch uses. In total, we captured 82 *Ctenosaura flavidorsalis*, which we consider are enough for population genetics. Martínez-González (2015) showed that 22 samples is enough to obtain most of the genetic variation within a *C. oaxacana* population.

In Bocao and La Cruz, Nicaragua, iguanas were scarce, not easily observed, and difficult to capture our goal of 30 iguanas. Instead *C. quinquecarinata* samples were taken from Santa Rosa del Peñón, Department of Leon, and San Francisco del Norte, Department of Chinandega. In the first locality, we captured 13 males, six females, three hatchlings, plus nine tail tissue samples (N = 31). In the second locality we obtained 10 males, 15 females, five hatchlings, and 13 tail tissue samples (N = 43). In both areas, habitat features were very similar to those observed for *C. oaxacana*.



From right to left: M. Sc. Jorge Robleto, M. Sc. Gabriela Díaz-Juárez and Dr. Víctor H. Reynoso examining captured iguanas. Photo by Milton Ubeda.



Hatchling iguana *Ctenosaura quinquecarinata*. Photo by Milton Ubeda.

(Rioja *et al.* 2012, Diaz-Juarez 2014) and both species are similar in behavior.

In total, we captured 122 spiny-tailed iguanas. For each captured iguana we measured morphometric data (mass, snout-vent length, tail length, head length and width, and tibia length), extracted blood from the caudal vein, and took photographs in lateral, dorsal and ventral views. Blood samples were split into duplicates, in 1.5 mL Eppendorf tubes, in 95.6% ethanol. A sample duplicate was left with collaborators in each country. When it was impossible to extract the iguana from its refuge, we cut a small sample from the tail (N = 34 samples) to extract DNA from the muscle tissue. Unfortunately, we lost the opportunity for morphological information from these iguanas. In total, we obtained 156 samples of blood or tissue: 82 for *C. flavidorsalis* and 74 for *C. quinquecarinata*.

Conservation Concerns. During our fieldwork, we noted that both species (*C. flavidorsalis* and *C. quinquecarinata*) have reduced population sizes, evident in the big effort needed to capture 30 samples per locality. Their habitat is also very fragmented, mainly because of land use conversion for cattle ranches, agriculture, and urbanization. These activities generate open spaces, without vegetation cover or refuges that protect iguanas from the environment, predators, and limits their food availability. Their use of volcanic rock piles and cracks for refuges was unexpected and may be in response to forest lost. Contrary to *C. oaxacana* and *C. quinquecarinata*, *C. flavidorsalis* appears to have been actively adapting to human-modified habitats, since they were commonly observed in very altered sites, including burned corn and bean fields. However, more dense populations are still found in the preserved forests. We believe that the progressive isolation of populations will reduce genetic flow

between populations and promote differentiation and loss of genetic variation within populations. Finally, we observed severe habitat deterioration in La Guegue, Department of Bocao, Nicaragua, and we were unable to find any iguanas. People in the area said they are very difficult to find.

Another important threat contributing to decreasing small spiny-tailed iguana populations is intentional killing because of fear. In all localities, *C. flavidorsalis* and *C. quinquecarinata* are considered to be poisonous. Some people are even certain that iguanas may poison their cattle by biting them or even when cattle step on them.

One important outcome from this project has been establishing contact with local academics, especially in the University of Honduras and Nicaragua National University. One student from Nicaragua came to learn molecular techniques in our lab at the Instituto de Biología, National Autonomous University of Mexico (UNAM). This collaboration will assure future collaborative research in Nicaragua, where *C. quinquecarinata* is mostly distributed.

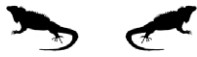
Future. The information we have gained about the biology and condition of the populations of *C. quinquecarinata* and *C. flavidorsalis* is still very limited. We think it is necessary to exhaustively explore the distribution area of each species to identify remnant areas that preserve good populations, establish the actual limits of distribution, define the number of subpopulations and their distributional pattern (continuous or in patches), and determine population size estimates for each species. Additionally, the study needs to consider iguana seasonality to assure complete understanding of the needs for both species, as we have done with *C. oaxacana*. Finally, we believe it is important to interview local people to determine the social importance of iguanas in each locality and to work with local academics and authorities to design conservation plans.

References

- Diaz-Juárez, G. 2014. Demografía e historia de vida de la iguana nguio (*Ctenosaura oaxacana*: Iguanidae), para su conservación y manejo en la región de Nizanda, Oaxaca. Master's Thesis, Instituto de Biología, UNAM, México D.F. 118 pp.
- Martínez-González C. 2015. Diversidad y estructura genética de la iguana nguio (*Ctenosaura oaxacana*: Iguanidae) en un bosque continuo y uno fragmentado del Istmo de Tehuantepec, Oaxaca, México. Bachelor's degree thesis, Facultad de Ciencias, UNAM, México D.F. 79 pp.

Hasbún, C.R., A. Gómez, G. Köhler and D.H. Lunt. 2005. Mitochondrial DNA phylogeography of the Mesoamerican spiny-tailed lizards (*Ctenosaura quinquecarinata* complex): historical biogeography, species status and conservation. *Molecular Ecology* 14:3095-3107.

Rioja, T., A. Carrillo-Reyes, E. Espinoza-Medinilla and S. López-Mendoza. 2012. Basic ecology of the Oaxacan Spiny-tailed Iguana *Ctenosaura oaxacana* (Squamata: Iguanidae), in Oaxaca, México. *Revista de Biología Tropical* 60(4):1613-1619.



Recent Literature

Abadi, M.S.M., Rostami, A. and Madani, S.A. 2017. A molecular survey of Chlamydial infection in pet and zoo captive reptiles in Tehran. *Iranian Journal of Veterinary Medicine* 11(3): 227-233.

Adi, Y.K. and Budipitojo, T. 2017. Confirmation of endocrine cells in the pancreas of *Iguana iguana* with immunohistochemistry. *Scholars Journal of Agriculture and Veterinary Sciences* 4(6): 245-248.

Aximoff, I. and Barreiros, P. 2017. *Iguana iguana* (Common Green Iguana) Predation. *Herpetological Review* 48(3): 649.

Chandler, M., See, L. Copas, K., Astrid, Bonde, A.M.Z., Lopez, B.C., Danielsen, F., Legind, J.K., Masinde, S., Miller-Rushing, A.J., Newman, G., Rosemartin, A. and Turak, E. 2017. Contribution of citizen science towards international biodiversity monitoring. *Biological Conservation* 213(B): 280-294.

De Jesus Villanueva, C. 2017. Tales from the "Iguana Girl": an anecdotal account of Puerto Ricans' interactions with and perceptions of invasive Green Iguanas (*Iguana iguana*). *IRCF Reptiles and Amphibians Conservation and Natural History* 24(1): 30-35.

De Oliveira, J.C.F. and Marcial de Castro, T. 2017. Range extension of *Iguana iguana* Linnaeus, 1758 (Squamata: Iguanidae): the first record of an established population in southeastern Brazil. *Check List* 13(2): 2097.

Espadas, D., Guíascon, R. Guíascon, R. and Gustavo, O. 2017. Uso medicinal de la fauna silvestre por comunidades Mayas, en la región de Los Chenes, Campeche, México. *Revista Etnobiología* 15(2): 68-83.

Fahrner, C. 2017. Predation on a chuckwalla, *Sauromalus ater* (Lacertilia: Iguanidae) by a Sonoran lyre snake, *Trimorphodon lambda* (Serpentes: Colubridae). *Southwestern Center for Herpetological Research* Fall: 50-51.

Fisher, R.N, Niukula, J., Watling, D. and Harlow, P.S. 2017. A new species of iguana *Brachylophus* Cuvier 1829 (Sauria: Iguania: Iguanidae) from Gau Island, Fiji Islands. *Zootaxa* 4273(3): 407-422.

González-Marín, R.M., Moreno-Casasola, P., Castro-Luna, A.A. and Castillo, A. 2017. Regaining the traditional use of wildlife in wetlands on the coastal plain of Veracruz, Mexico: ensuring food security in the face of global climate change. *Regional Environmental Change* 17(5): 1343-1354.

González-Sánchez, V.H., Johnson, J.D., Garcia-Pedilla, E., Mata-Silva, V., DeSantis, D.L. and Wilson, L.D. 2017. The herpetofauna of the Mexican Yucatan Peninsula: composition, distribution, and conservation status. *Mesoamerican Herpetology* 4(2): 263-380.

Hellebuyck, T., Questel, K., Pasmans, F., Van Brantegem, L., Philip, P. and Martel, A. 2017. A virulent clone of *Devriesea agamarum* affects endangered Lesser Antillean Iguanas (*Iguana delicatissima*). *Scientific Reports* 7(12491): 1-6.

Huey, R.B. and Pianka, E.R. 2017. Body temperature distributions of active diurnal lizards in three deserts: Skewed up or skewed down? *Functional Ecology*. 32(2): 334-344.

Ibáñez, A., Menke, M., Quezada, G., Jiménez-Uzcátequi, G., Schulz, S. and Steinfartz, S. 2017. Diversity of compounds in femoral secretions of Galápagos iguanas (genera: *Amblyrhynchus* and *Conolophus*, and their potential role in sexual communication in lek-mating Marine Iguanas *Amblyrhynchus cristatus*). *PeerJ* 5(1): e3689-24.

Iverson, J.B., Francois, K., Jollay, J., Buchner, S.D. and Knapp, C.R. 2017. *Cyclura cychlura figginsii* (Exuma Rock Iguana). *Allogrooming*. *Herpetological Review* 48(1): 188.

Lewbart, G.A., Hirschfeld, M., Ricaurte, O. and Lohmann, K.J. 2017. *Amblyrhynchus cristatus* (Marine Iguana) Diet. *Herpetological Review* 48(2): 432.

Lindenmayer, D. and Scheele, B. 2017. Do not publish. *Science* 356(6340): 800-801.

Loss, S.R. and Marra, P.P. 2017. Population impacts of free-ranging domestic cats on mainland vertebrates. *Frontiers in Ecology and the Environment* 15(9): 502-509.

Malone, C.L., Reynoso, V.H. and Buckley, L. 2017. Never judge an iguana by its spines: Systematics of the Yucatán Spiny-tailed Iguana, *Ctenosaura defensor* (Cope, 1866). *Molecular Phylogenetics and Evolution* 115: 27-39.

Meiri, S., Bauer, A.M., Allison, A., Castro-Herreras, F., Chirio, L., Colli, G., Das, I., Doan, T.M., Glaw, F., Grismer, L.L., Hoogmoed, M., Kraus, F., LeBreton, M., Meirte, D., Nagy, Z.T., de C. Nogueira, C., Oliver, P., Pauwels, O.S.G., Pincheira-Donoso, D., Shea, G., Sindaco, R., Tallowin, O.J.S., Torres-Carvajal, O., Trape, J.F., Uetz,

P., Wagner, P., Wang, Y., Ziegler, T. and Roll, U. 2017. Extinct, obscure or imaginary: The lizard species with the smallest ranges. *Diversity and Distributions* 24(2): 262-273.

Melstrom, K.M. 2017. The relationship between diet and tooth complexity in living dentigerous saurians. *Journal of Morphology* 278(4): 500-522.

Miralles, A., MacLeod, A., Rodriguez, A., Ibáñez, A., Jiménez-Uzcátequi, G., Quezada, G., Vences, M. and Steinfartz, S. 2017. Shedding light on the Imps of Darkness: an integrative taxonomic revision of the Galápagos Marine Iguanas (genus *Amblyrhynchus*). *Zoological Journal of the Linnean Society* 181(3): 678-710.

Mundo-Hernández, V., Martínez-Haro, M., Balderas, M.A., Némiga, X.A. and Manjarrez, J. 2017. A new locality for *Ctenosaura pectinata* (Wiegmann, 1834) (Squamata: Iguanidae) in central Mexico, with implications for its conservation. *Mesoamerican Herpetology* 4(1): 222-224.

Pasachnik, S.A. and Martin-Velez, V. 2017. An evaluation of the diet of *Cyclura* iguanas in the Dominican Republic. *The Herpetological Bulletin* 140: 6-12.

Rambaldi, S. 2017. *Cyclura lewisi* (Blue Iguana) Social behavior". *Herpetological Review* 48(2): 435-436.

Reynoso, V.H., Monteverde, M.J., Martínez-González, C., Zarza, E. and Cerdá-Ardura, A. 2017. Geographic distribution: *Sauromalus hispidus* (Spiny Chuckwalla). *Herpetological Review* 48(1): 126.

Rideout, B.A., Sainsbury, A.W. and Hudson, P.J. 2017. Which parasites should we be most concerned about in wildlife translocations? *EcoHealth* 14(Suppl 1): 42-46.

Roberto, I.J., de Oliveira, C.R., de Araujo Filho, J.A., de Oliveira, H.F. and Avila, R.W. 2017. The herpetofauna of the Serra do Urubu mountain range: a key biodiversity area for conservation in the Brazilian Atlantic forest. *Papéis Avulsos de Zoologia (São Paulo)* 57(27): 347-373.

Rousselet, E., De Mello Souza, C.H., Wellehan Jr., J.F.X., Epperson, E.D., Dark, M.J. and Wamsley, H.L. 2017. Cutaneous iridophoroma in a Green Iguana (*Iguana iguana*). *Veterinary Clinical Pathology* 46(4): 625-628.

Roux, C.Z. 2017. Basal metabolic rate scaled to body mass within species by the fractal dimension of the vascular system and body composition. *South African Journal of Animal Science* 47(4): 494.

Rovatsos, M. and Kratochvíl, L. 2017. Molecular sexing applicable in 4,000 species of lizards and snakes? From dream to real possibility. *Methods in Ecology and Evolution* 8(8): 902-906.

Stabile, J.L. 2017. Perspectives in conservation: an interview with Rick Hudson. *Herpetological Review* 48(1): 88-92.

Steadman, D.W., Albury, N.A., Mead, J.I., Soto-Centeno, A. and Franklin, J. 2017. Holocene vertebrates from a dry cave on Eleuthera Island, Commonwealth of The Bahamas. *The Holocene* 28(5): 806-813.

Steadman, D.W., Singleton, H.M., Delancy, K.M., Albury, N.A., Soto-Centeno, J.A., Gough, H., Duncan, N., Franklin, J. and Keegan, W.F. 2017. Late Holocene historical ecology: the timing of vertebrate extirpation on Crooked Island, Commonwealth of The Bahamas. *The Journal of Island and Coastal Archaeology* 12(4): 572-584.

Tavassoli, M., Javadi, S., Khazaei, K. and Gharekhani, J. 2017. *Hirstiella* sp. (Acari: Pterygosomatidae) infestation in Green Iguana (*Iguana iguana*) from Urmia, Iran. *Persian Journal of Acarology* 6(1): 63-65.

Teles, D.A., Brito, S.V., Teixeira, A.A.M., Ribeiro, S.C., Araujo-Filho, J.A., Lima, V.F., Pereira, A.M.A. and Almeida, W.O. 2017. Nematodes associated with *Iguana iguana* (Linnaeus, 1758) (Squamata, Iguanidae) in semi-arid areas of Northeastern Brazil. *Brazilian Journal of Biology* 77(3): 514-518.

Tompkins, P. and Wolff, M. 2017. Galápagos macroalgae: a review of the state of ecological knowledge. *Revista de Biología Tropical* 65(1): 375-392.

Toral-Granda, M.V., Causton, C.E., Jäger, H., Trueman, M., Izurieta, J.C., Araujo, E., Cruz, M., Zander, K.K., Izurieta, A. and Garnett, S.T. 2017. Alien species pathways to the Galápagos Islands, Ecuador. *PLoS ONE* 12(9): e0184379.

Usherwood, J.R. and Self Davies, Z.T. 2017. Work minimization accounts for footfall phasing in slow quadrupedal gaits. *eLife* 2017(6): e29495.

Valdivia-Carrillo, T., García-De León, F.J., Blázquez, M.C., Gutiérrez-Flores, C. and González Zamorano, P. 2017. Phylogeography and ecological niche modeling of the Desert Iguana (*Dipsosaurus dorsalis*, Baird & Girard 1852) in the Baja California Peninsula. *Journal of Heredity* 108(6): 640-649.

van Veen, R. and Wilson, B.S. 2017. Predation of Jamaican Rock Iguana (*Cyclura collei*) nests by the invasive Small Asian Mongoose (*Herpestes auropunctatus*) and the conservation value of predator control. *Herpetological Journal* 27: 201-216.

Welch, M.E., Colosimo, G., Pasachnik S.A., Malone, C.L., Hilton, J., Long, J., Getz, A.H., Alberts, A.C. and Gerber, G.P. 2017. Molecular variation and population structure in Critically Endangered Turks and Caicos Rock Iguanas: identifying intraspecific conservation units and revising subspecific taxonomy. *Conservation Genetics* 18(2): 479-493.

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Reminder: Next ISG Meeting Dates!

Annual ISG Meeting 2018
4-8 November
Held at the Fort Worth Zoo, Fort Worth, TX
Check the [website](#) for details!



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