



**2016 IUCN SSC Iguana Specialist Group Annual Meeting  
Musket Cove Island Resort and Marina,  
Malolo Lailai, Fiji**

**30 October 2016**

**Pre-meeting field trip to Malolo and Monuriki Islands**

Overview of the iguana habitat restoration program and headstart facility on Malolo. Half-day trip to Monuriki Island (31 October) for review of iguana reintroduction program, including successful invasive species removal.

**31 October 2016**

**5 – 7:00 pm** Pre-meeting Ice Breaker: cocktail and nibbles party at Musket Cove Resort patio/bar. Musket Cove's Monday Night Fiji Curry Buffet available for dinner afterward, on own account.

**1 November 2016**

- 9:00 am**      **Welcome and self-introductions**  
ISG Co-Chairs: Chuck Knapp and Stesha Pasachnik
- 9:15 am**      **Opening Welcoming and Address**  
Mason Smith, IUCN Oceania  
Joshua Wycliffe, Permanent Secretary for Local Government, Housing, and Environment
- 9:30 am**      **Vote of Thanks**  
IUCN Fiji, ISG Co-Chairs
- 9:45 am**      **Information** about venue and surrounding area (Robert Fisher and Kim Lovich)
- 9:50 am**      **Nesting Ecology of *Cyclura nubila caymanensis* on Little Cayman**  
Moss, Jeanette, Glenn Gerber\*, Mark Welch, and Jessica Harvey
- 10:10 am**     **An Update on the Jamaican Iguana Recovery Program – Status in the Hellshire Hills and an Evaluation of Portland Ridge for Reintroduction**  
van Veen, Rick\*, Damion Whyte, Stesha Pasachnik\*, and Eric Garraway
- 10:30 am**     **BREAK**



- 10:50 am**      **On-going Research and Monitoring of the Repatriated and Translocated Subpopulation of the Sandy Cay Rock Iguana (*Cyclura rileyi cristata*) in the Moriah Harbour Cay National Park, Exuma**  
Buckner, Sandra, Jill M. Jollay\*, John B. Iverson, Shannan S. Yates, and Susannah S. French
- 11:10 am**      **A Study of the Natural History, Demography, and Dispersal Behavior of a Critically Endangered Island Endemic, Uta Spiny-tailed Iguana, *Ctenosaura bakeri***  
Maryon, Daisy F. \*, David C. Lee, Stesha A. Pasachnik, and Steven Clayson
- 11:30 am**      **Nesting Ecology and Habitat Temporal Change Analysis of the Critically Endangered *Ctenosaura bakeri***  
Diotallevi, Flavia\*, David C. Lee, Malcolm Thomas, Daisy Maryon, Stesha Pasachnik, and Steven Clayson
- 11:50 am**      **LUNCH**
- 1:30 pm**      **Effects of Habitat Fragmentation in the Genetic Variation of *Ctenosaura oaxacana***  
Martínez-González, Carmina\*, and Víctor Hugo Reynoso-Rosales
- 1:50 pm**      **An Update on the Work of Zootropic with *Ctenosaura palearis* in the Valle de Motagua, Guatemala**  
Ariano, Daniel and Johana Gil (presented by Stesha Pasachnik)
- 2:10 pm**      **Distribution and Abundance of *Sauromalus hispidus* in the Islands of Baja California**  
Reynoso, Víctor H. \*, Eugenia Zarza, Nancy Gabriela Santos Hernández, Carmina Martínez-González, María José Monteverde-Suarez, Yssel Gadar Aguayo, Ángel Bernardo Villarreal Medina, and Román Becerra Reynoso
- 2:30 pm**      **BREAK**
- 2:50 pm**      **St. Eustatius' Iguana Population: Pure *Iguana delicatissima*, but Genetically Depleted**  
van den Burg, Thijs\*, Mark Welch, Hannah Madden, Bart Kluskens, Hans Breeuwer, and Patrick Meirmans
- 3:10 pm**      **Minimizing Non-target Impacts on Native Iguanas in Island Rodent Eradications in the Tropics**  
Samaniego-Herrera, Araceli\*
- 3:30 pm**      **Assessing the Effects of Tourism and Food Provisioning on Physiological Systems Critical to Self-maintenance and Survival of Exuma Rock Iguanas (*Cyclura cyclura*) in The Bahamas**  
Webb, Alison, Charles Knapp\*, Dale DeNardo, John Iverson, and Susannah French



- 3:50 pm**      **Poster Session with Presenter Introductions** (In alphabetical order by last name)
- The Diet of Feral Cats (*Felis catus* L.) in Cabritos Island in the Dominican Republic**  
De la Rosa, Víctor I., and Rosanna Carreras De León. *\*Presented by Stesha Pasachnik*
- Monitoring an Endangered Iguana and Cultivating the Next Generation of Researchers & Managers**  
Goode, Ashley and Stesha Pasachnik\*
- Conservation in Action: A Grass Roots Project to Save Utila's Endemic Iguana**  
Maryon, Daisy\*, Holly Black, Ashley Zubeck, Andrea Albergoni, Tom Brown, Steven Clayson, Andrea Martinez, Flavia Diotallevi, and Marisa Sorrell

- 4:30 pm thru PM**      **Working Session for Red List Assessors:**  
*Tandora Grant, Chuck Knapp, Stesha Pasachnik, Glenn Gerber, Catherine Malone, Carmina Martinez, Victor Reynoso, Thijs van den Burg*

- 5:00 pm**      **Steering Committee Meeting (closed)**  
Closed: Alberts, Gerber, Grant, Harlow, Knapp, Malone, Pasachnik

## 2 November 2016

- 9:00 am**      **Daily agenda review, meeting logistics update**  
Chuck Knapp, Stesha Pasachnik, Robert Fisher, Kim Lovich
- 9:10 am**      **Biosecurity Authority of Fiji Mandate and Current Work on Invasives, Including Green Iguanas in Fiji**  
Jainesh Ram and Monika Devi, Biosecurity Authority of Fiji
- 9:30 am**      **Management Actions on Grand Cayman: Controlling Green Iguana Overabundance**  
Haakonsson, Jane (remotely)\*, Jessica Harvey, and Frank Rivera-Milán
- 10:00 am**      **Invasive Species Efforts in the Pacific – A View from 40,000 Feet and Opportunities for Green Iguana Efforts in Fiji**  
Andreozzi, Phil
- 10:30 am**      **BREAK**
- 10:50 am**      **Wildlife Services in the Pacific Theater**  
Gosnell, Rob
- 11:20 am**      **Hybridization: A New Threat from Invasive Green Iguanas (*Iguana iguana*) to the Endemic Sister Islands Rock Iguana (*Cyclura nubila caymanensis*) of Little Cayman**  
Houlcroft, Edward, and Michael Vallee\*



- 11:40 am**      **Removal and Management of a Population of Green Iguanas (*Iguana iguana*) from a Bahamian Island**  
Wasilewski, Joseph\*, Edward Metzger, and Nick Wasilewski
- 12:00 pm**      **Update on the Final Invasive Iguana Position Statement**  
Stesha Pasachnik and Chuck Knapp
- 12:15 pm**      **LUNCH**
- 1:30 pm**      **Invasive Iguana Discussion**  
ISG Officers, All
- 2:15 pm**      **Iguana Smuggling Discussion**  
ISG Officers, All
- 3:00 pm**      **BREAK**
- 3:20 pm**      **Genetics Working Group Update**  
Catherine Malone
- 3:40 pm**      **Update on Iguana Recovery Plans and their Implementation** (white paper)  
Pagni, Lee (presented by Tandora Grant)
- 3:50 pm**      **ISG Year in Review, Red List Update, New Membership Term 2017–2020, Steering Committee Succession, CITES Permit**  
Tandora Grant, Chuck Knapp
- 4:10 pm**      **Next meeting location**  
Stesha Pasachnik, Chuck Knapp, Tandora Grant, All
- 4:20 pm**      **Travel Awardees Update**  
Stesha Pasachnik
- 4:30 pm**      **Working Session for Red List Assessors:**  
**thru PM**      *Tandora Grant, Chuck Knapp, Stesha Pasachnik, Glenn Gerber, Catherine Malone, Carmina Martinez, Victor Reynoso, Thijs van den Burg*

**Dinner Options:**

Dicks Place Bar and Bistro – poolside; a la carte or buffet with evening entertainment  
*Reservations are required for bookings of 6 or more*

Trader Cafe – overlooking the Marina, healthy bistro cuisine including pizza, homemade pies, and smoothies. Take away available.

MCYC Island Bar and BBQ – cook your own BBQ (*must be booked before 4pm on the day of dining*).

Trader General Store – fresh fruit/vegetables from Musket’s organic farm, fresh baked breads, grocery/deli items.



**IUCN SSC Iguana Specialist Group Annual Meeting  
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1–2 November 2016**

**ORAL PRESENTATION ABSTRACTS**

**In alphabetical order by submitter's last name, presenter denoted by \***

**Invasive Species Efforts in the Pacific – a View from 40,000 ft. and Opportunities for Green Iguana Efforts in Fiji**

Andreozzi, Phil\*

U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Pacific Biosecurity Coordinator, Washington, D.C., USA

In recent years, the issue of invasive species has gained unprecedented attention in the Pacific at the highest levels of regional, national, and local government as well as with non-governmental organizations. Invasive species are now acknowledged as not only a fundamental threat to Pacific island biodiversity, but the prevention, mitigation, and eradication of invasive species are also recognized as a core component of efforts to protect and enhance climate resilience, food security, and human health as well as maintain livelihoods, quality of life, and sustainable development efforts. This heightened awareness and the high-level commitments it has spawned, as well as enhanced multi-lateral collaborative efforts amongst invasive species experts in the Pacific, provide excellent opportunities for partners trying to address important, looming invasive species threats – such as the Green Iguana invasion in Fiji. This presentation will highlight the growing awareness in the region and focus on collaborative efforts that invasive species practitioners can learn from and partner with to gain support for their actions.

**Assessment of the Seed Dispersal Ecosystem Service Given by the Guatemalan Black Iguana *Ctenosaura plearis***

Ariano-Sánchez, Daniel<sup>1</sup>, Johana Gil-Escobedo<sup>2</sup>, Alejandro Vásquez-Contreras<sup>3</sup>

\*Presented by Stesha Pasachnik, Fort Worth Zoo, Texas, USA

<sup>1</sup>Reserva Natural para la Conservación del Heloderma y el Bosque Seco del Valle del Motagua, Asociación Zootropic, Guatemala; <sup>2</sup>Escuela de Biología, Universidad de San Carlos de Guatemala; <sup>3</sup>Departamento de Biología, Universidad del Valle de Guatemala

*Ctenosaura palearis* is an endangered endemic iguana of the dry forests of Guatemala. The objectives of the study were to assess the seed dispersal ecosystem service provided by the iguana through radiotracking, and also seed germination assessments of seeds of the Organ Pipe Cactus (*Stenocereus pruinosus*) that had passed through the digestive tract of the iguana *C. palearis*. Radiotracking was made during the months of June to December 2015 with a total of 308 relocations. To determine the role of endozoochory by *C. palearis* on the germination success of *S. pruinosus*, we carried four in vitro germination experiments. The treatments were (a) inhibited seeds, (b) manually extracted seeds, (c) iguana-ingested and sterilized seeds and (d) Iguana ingested seeds, totalizing 200 seeds per experiment. Germination percentage of iguana ingested seeds (26.1%) was significantly higher ( $p < 0.001$ ) than any other treatment. The average home range of the *C. palearis* was  $3.84 \pm 2.17$  ha. The average home range for males was  $4.07 \pm 1.65$  ha and for females was  $3.16 \pm 4.28$  ha. There were significant differences ( $p < 0.01$ ) in average home range between dry season ( $4.60 \pm 2.18$  ha) and rainy season ( $0.88 \pm 1.12$  ha). Taking into account that the germination of seeds of *S. pruinosus* is positively affected by *C. palearis* ingestion and that the iguana covers a relatively large area in their movements at the time fruiting occurs (dry season, 4.60 ha), we can conclude that *C. palearis* is an effective seed disperser for the cacti and consequently have a fundamental role on the seed dispersal ecosystem service in the dry forests of Motagua Valley, Guatemala. We thus encourage including this iguana as a key element in local conservation efforts of the tropical dry forest.

### **On-going Research and Monitoring of the Repatriated and Translocated Subpopulation of the Sandy Cay Rock Iguana (*Cyclura rileyi cristata*) in the Moriah Harbour Cay National Park, Exuma**

Buckner, Sandra<sup>1</sup>, Jill M. Jollay\*<sup>2</sup>, John B. Iverson<sup>3</sup>, Shannan S. Yates<sup>3</sup>, and Susannah S. French<sup>3</sup>  
<sup>1</sup>Bahamas National Trust, Nassau, The Bahamas; <sup>2</sup>Independent; <sup>3</sup>Earlham College, Richmond, Indiana, USA; <sup>3</sup>Utah State University, Logan, Utah, USA

The Rock Iguana subspecies *Cyclura rileyi cristata* was restricted to one population located on Sandy Cay in the southeastern Exuma Cays and the subspecies is classified as Critically Endangered under the IUCN categories. On 3 February 2014, 13 iguanas were found by UK Border Force smuggled in the luggage of two passengers arriving at London Heathrow Airport from The Bahamas. On 9 July 2014, the 12 living iguanas were repatriated and quarantined at the Gerace Research Centre on San Salvador. The remaining nine surviving iguanas, determined to be eight males and one female, were released on to an uninhabited cay in the Exumas on 13 September 2014. On 26 March 2015, 27 iguanas (twenty-five males and two females) were translocated from the source cay to this new cay. The status of the population has been assessed in July 2015, March 2016, and June 2016. Iguanas caught were weighed, measured, and examined to assess their overall condition. The iguanas had grown, gained weight, and looked healthy.

## **Nesting Ecology and Habitat Temporal Change Analysis of the Critically Endangered *Ctenosaura bakeri***

Diotallevi, Flavia\*<sup>1</sup>, David C. Lee<sup>1</sup>, Malcolm Thomas<sup>1</sup>, Daisy Maryon<sup>1,2</sup>, Stesha Pasachnik<sup>3</sup>, and Steven Clayson<sup>2</sup>

<sup>1</sup>University of South Wales, Pontypridd, United Kingdom; <sup>2</sup>Kanahau, Utila Research and Conservation Facility, Utila, Honduras; <sup>3</sup>Fort Worth Zoo, Fort Worth, Texas, USA

The Utila Spiny-tailed iguana, *Ctenosaura bakeri*, is a mangrove-dwelling reptile endemic to the Island of Utila. Over the last 100 years there has been a major decline in the population, bringing this species to the status of Critically Endangered. This is primarily due to hunting for human consumption and habitat loss from island development. The literature states that *C. bakeri* exclusively nests in sandy beaches, in areas adjacent to the mangroves. From the beginning of March 2016, gravid *C. bakeri* were radio-tracked and nests were located and recorded. In this ongoing study, the habitat immediately surrounding the *C. bakeri*'s nest is being studied, in terms of ground cover, through the Point Frame method. A plot of 400m<sup>2</sup> is designed around a clutch of nests and then subdivided into 16 quadrats measuring 5x5m. Within each quadrat, 160 points are collected by using the Point Frame, obtaining point samples to estimate the ground cover. The distance between nests is recorded. A line transect is also conducted between the nest plots and the nearest mangrove area.

Through the study of satellite imagery, this study also aims at establishing how much habitat has been modified in the recent past due to high increase in tourism. So far, it has been found that there is variability in the habitat type of the located nests. While some were found in open sandy areas, others were located underneath dense vegetation; others were located in seafront private properties.

The identification of sensitive areas that are potential or current nesting habitats could provide useful information for habitat management strategies and environmental consultancy guidelines for future prospecting, and ultimately provide information on which areas should be protected and managed in order to reduce the negative impact on the endemic population.

## **Wildlife Services in the Pacific Theater**

Gosnell, Robert

U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Guam

Our mission is to provide leadership and expertise in resolving human and wildlife conflicts to protect: Agriculture; Natural Resources; Property; and Human Health and Safety. Wildlife Services (WS) has a proven track record in dealing with: Brown Tree Snake control and interdiction; rodent eradication; Monitor Lizard control; wildlife hazard management at airports; ungulate control; wildlife hazard assessments; avian control; and threatened and endangered species conservation.

The Common Green Iguana (*Iguana iguana*) is considered a highly invasive species. The overabundance has been a concern to resource managers and may cause significant adverse damage to infrastructure, economy, and the ecosystem. WS recommends an integrated wildlife damage management approach in controlling the damage caused by the Common Green Iguana. Control methods that should be considered are: active removal, trapping, nest destruction, exclusion, and WS is able to provide additional technical assistance in this arena.

### **Management Actions on Grand Cayman: Controlling Green Iguana Overabundance**

Haakonsson, Jane Ebert\*<sup>1</sup>, Jessica Harvey<sup>1</sup>, and Frank F. Rivera-Milán<sup>2</sup>

<sup>1</sup>Department of Environment, Grand Cayman, Cayman Islands; <sup>2</sup>United States Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, Maryland, USA.

Common Green Iguana (*Iguana iguana*) overabundance is a rising concern to resource managers throughout the Caribbean. Overabundance of this highly invasive species can have significant adverse economic and environmental effects including risks to species of conservation concern through competition, depredation, and defoliation of native vegetation. In this presentation, we provide information about the 2016 Green Iguana Removal Strategy, before and after-removal surveys, general logistics involved in an organized control effort, data collected, and analysis. In February-June 2016, we estimated abundance (density and population size) and population rate of change ( $R_t = N_{t+1}/N_t$ ) of Green Iguanas using distance sampling and repeated counts at three spatial scales. A “systematic cull” (pilot 1) was conducted at three discrete sites (120 ha) by three individual hunters through 23 May-13 June, and an “open cull” (pilot 2) was conducted in a larger removal area (4,302 ha) with 19 registered hunters through 20-26 June 2016. We collected removal data to estimate the number of iguanas shot and retrieved (as well as crippling loss), biological data (e.g., weight, sex, number of gravid females and eggs) at the beginning and end of both pilots, and removal statistics (iguanas removed per hour) to assess hunter efficiency. Pilot 1 removed 4,370 Green Iguanas during 151 hunting hours, and pilot 2 removed 14,468 Green Iguanas (~16 tons) during a total of 567 hunting hours. Pilot 1 before- and after-removal surveys showed a 93% population decline in three discrete areas, with the second after-removal survey 10 days later ( $t = 10$ ) showing an 82% population increase, most likely through immigration from neighboring inaccessible mangrove forest and water channels.

### **Hybridization: A New Threat from Invasive Green Iguanas (*Iguana iguana*) to the Endemic Sister Islands Rock Iguana (*Cyclura nubila caymanensis*) of Little Cayman, Cayman Islands**

Houlcroft, Edward, and Michael Vallee\*

Green Iguana B'Gonna program (National Trust for the Cayman Islands), Little Cayman, Cayman Islands

Common Green Iguanas (*Iguana iguana*) are present as an invasive species throughout the Caribbean, southern United States, and some areas in the South Pacific. Maximum entropy niche-modelling algorithms have predicted suitable conditions for *I. iguana* in all of the islands of the Greater Caribbean Basin (Falcón et al. 2012). Their arrival to Little Cayman comes from a supply barge which travels from Grand Cayman, with the first capture being recorded in 2007. Evidence of the negative impact towards the ecology and economy of invaded islands has been assessed in Puerto Rico (López-Torres et al. 2011) and Grand Cayman. The small island ecosystem of Little Cayman (10 km<sup>2</sup>) means that *I. iguana* could cause a serious imbalance to the island's flora and fauna. Until now it was theorized that Little Cayman faced similar threats to other invaded islands. The endemic Sister Islands Rock Iguana, found only on Little Cayman and the adjacent Cayman Brac, would suffer competition with the invading *I. iguana*. In August 2016, a unique hatchling was observed on Little Cayman, and upon capture the juvenile appeared to share phenotypic characteristics of both *I. iguana* and *Cyclura nubila caymanensis*. Immediate expert analysis hypothesized that the hatchling, as well as two caught later that same week, were hybrids from the interbreeding of *I. iguana* and *C. n. caymanensis*. This new threat of potentially sexually viable hybrids increases the risk of the invading *I. iguana* population to the endemic *C. n. caymanensis* population, and enhances the need not only to protect the ecosystem of Little Cayman, but the genetic structure of the endemic iguana. It is possible that other *Cyclura* species of iguana could be threatened by hybridization, so relevant islands should look at this as a potential new threat for their endemic iguanas too.

### **Effects of Habitat Fragmentation in the Genetic Variation of *Ctenosaura oaxacana***

Martínez-González, Carmina\*, and Víctor Hugo Reynoso-Rosales

Instituto de Biología, Universidad Nacional Autónoma de México, México City, México

Human activities have threatened several species. Among iguanas endemic to Mexico, *Ctenosaura oaxacana* faces hunting and habitat fragmentation and destruction. We evaluated the effect of habitat fragmentation in the genetic structure of two populations. Using seven microsatellite markers we compared populations of a continuous forest, Nizanda (N = 37), and a fragmented forest, Paja Blanca (N = 28). In both localities evolutionary forces seem to be not active (i.e., Hardy-Weinberg equilibrium). Paja Blanca has a lower heterozygosity value than Nizanda ( $H_{O(PB)} = 0.217$  vs.  $H_{O(N)} = 0.519$ ), and both populations have lower heterozygosity compared to other continental iguana populations, but similar to insular populations. There is genetic structure between both populations ( $F_{ST} = 0.292$ ;  $R_{ST} = 0.801$ ), and each one has its own genetic identity with unique alleles; 25 alleles are unique for each locality. The difference between  $F_{ST}$  and  $R_{ST}$  values suggest that the main variation source is mutations. In Paja Blanca a single genetic population exists, but Nizanda is structured with two genetic populations that are perfectly distinguished. This structure can be caused by Wahlund, metapopulation, or migratory effects.

Habitat fragmentation has negative effects on the genetic variation of *C. oaxacana* and small distribution areas result in the loss of genetic variation. Moreover, the increment of geographic

distance among populations and the low vagility of *C. oaxacana* cause isolation between populations, similar to that of insular populations. Thereby, the genetic variation depends strictly on mutations.

### **A Study of the Natural History, Demography, and Dispersal Behaviour of a Critically Endangered Island Endemic, Utila Spiny-tailed Iguana *Ctenosaura bakeri***

Maryon, Daisy F.\*<sup>1,3</sup> David C. Lee<sup>1</sup>, Stesha A. Pasachnik<sup>2</sup>, and Steven Clayson<sup>3</sup>

<sup>1</sup>University of South Wales, Pontypridd, United Kingdom; <sup>2</sup>Fort Worth Zoo, Fort Worth, Texas, USA; <sup>3</sup>Kanahau Utila Research and Conservation Facility, Utila, Honduras.

*Ctenosaura bakeri* is a Critically Endangered iguana species endemic to the island of Utila, Honduras. It is known to occur throughout the island (41 km<sup>2</sup> extent of occurrence), however it likely occupies less than 25% (10 km<sup>2</sup>) of the total area as it is only found in certain mangrove habitat areas. This project was started in late January 2016 and fieldwork will continue to early September 2016. We aim to provide an up-to-date estimate of population size, using capture mark-recapture methods and line transects. Hybridization with another Ctenosaur species on the island, *C. similis*, is a theorized threat to *C. bakeri* so DNA samples are being collected from both species to investigate this and give an update to the 2008 study by Pasachnik et al. Very little is known about the nesting behaviour of *C. bakeri*, we are investigating this currently using radio-telemetry. We have tracked gravid females to nesting sites with some surprising results and gathered information about behavior and home range in both females and males. The mangrove inhabited by *C. bakeri*, as well as their nesting sites, are under threat from increasing tourism enterprises and economic development on the island. Hunting of all iguanas, including *C. bakeri*, is rife throughout Utila with gravid females being particularly highly prized. Observations of hunting were made almost daily at various field sites over the breeding season (February until June). Questionnaires were given out in the community to investigate the local attitudes towards the iguana species, and sought to gain insight into hunting activity on the island. This species and its habitat requires protection at a local level, with improved enforcement of existing anti-hunting laws and increased control of development. This project aims to contribute vital evidence that immediate conservation action is necessary.

### **Nesting Ecology of *Cyclura nubila caymanensis* on Little Cayman**

Moss, Jeanette<sup>1</sup>, Glenn Gerber\*<sup>2</sup>, Mark Welch<sup>1</sup>, and Jessica Harvey<sup>3</sup>

<sup>1</sup>Mississippi State University, Mississippi State, Mississippi, USA; <sup>2</sup>San Diego Zoo Institute for Conservation Research, Escondido, California, USA; <sup>3</sup>Department of Environment, Grand Cayman, Cayman Islands

*Cyclura nubila caymanensis*, commonly known as the Sister Islands Rock Iguana, is a Critically Endangered taxon endemic to Little Cayman (LC) and Cayman Brac (CB). For the second successive field season, nesting studies were conducted on the West End of LC to investigate

trends in habitat use and nesting ecology. Surveys found overall fewer nests in 2016 than in previous years, which may reflect population declines. The 2015 and 2016 datasets were analyzed spatio-temporally for evidence of communal synchronization, a strategy that may arise given high rates of interference competition. While data does not support this hypothesis, surveys discovered a nest reentry rate by successive nesters of 60% in 2016 at a major communal site. This nest-sharing behavior resulted in substantial damage to eggs in at least one instance, although high rates of hatching success amongst the majority of clutches in 2015 suggest that the benefits of social digging may outweigh the costs.

Among the females tagged at nesting sites in 2015, at least 65% exhibited site fidelity in 2016. Radio telemetry methods were employed to track the migrations of 20 nesting females in 2016, resulting in dispersal distances of up to 2.9 km. Home territories were not localized but widely distributed throughout the West End's interior dry forest, indicating that high quality habitat is still readily available on LC. Current actions to promote the long-term maintenance of a breeding population should therefore include the establishment of large, contiguous protected areas. Our nesting studies point to healthy population fecundity, however, very low recapture rates (only 3 of 228 hatchlings tagged in 2015 were recaptured in 2016) suggest survivorship, and thus recruitment, may be low. Even from this limited dataset it is clear that dispersal rates are high, as yearlings were recaptured up to 15 km from their natal sites.

### **Update on Iguana Recovery Plans and their Implementation**

Pagni, Lee

Studio Mundo

Action plans for iguana recovery are an important part of the ISG's efforts. These plans play a unique role in connecting the science of iguana conservation to a larger audience including regional and global actors. While there are certainly problems with action plans: only a portion of iguana species have published plans, most planning timelines are no longer current, and there is limited implementation of actions listed in the plans; both the process of developing action plans and implementing them have benefits beyond the documents themselves. Drawing on my experience with iguana action plan development and implementation, I discuss the issues involved with actions plans and make a case for why the ISG should prioritize support for them.

### **Distribution and Abundance of *Sauromalus hispidus* in the Islands of Baja California**

Reynoso, Víctor H.\*, Eugenia Zarza, Nancy Gabriela Santos Hernández, Carmina Martínez-González, María José Monteverde-Suarez, Yssel Gadar Aguayo, Ángel Bernardo Villarreal Medina and Román Becerra Reynoso.

Instituto de Biología, Universidad Nacional Autónoma de México (UNAM), México City, México

The Gulf of California insular system shelters four iguana genera (*Ctenosaura*, *Sauromalus*, *Dipsosaurus*, and *Iguana*) with 12 species, being the most diverse iguana site in the world. One of the most iconic species, *Sauromalus hispidus*, is endemic to the Bahía de Los Ángeles Archipelago, and the San Lorenzo, Ánimas, and Ángel de la Guarda islands. Since 2013, we have conducted surveys visiting all islands where the species has been previously reported as well as other adjacent islands and closest mainland sites. All surveys were standardized with collecting effort of 48 man-hours per island, independently of its size. All islands have been surveyed once so far and we recorded every iguana seen or collected for blood sampling. We collected 144 iguanas from eight known islands and nine iguanas from five new localities. We did not, however, find evidence of iguanas within two previously documented sites. One known locality deserves special attention since, in spite of what is reported in literature, we have only found three living iguanas during four visits in four sites along the main island (192 man-hours effort). This is a large island and is considered important for this species. In this island we have found several remains of predated iguanas together with cat traces and scats. Camera traps have shown that cats are distributed all along the visited places suggesting that cats are widely distributed in the island and may be threatening the species.

### **Minimizing Non-target Impacts on Native Iguanas in Island Rodent Eradications in the Tropics**

Samaniego-Herrera, Araceli\*

Grupo de Ecología y Conservación de Islas, A.C., Ensenada, B.C., México

The 600+ rodent eradication attempts on islands worldwide reflects the wide use of this tool as one of the most efficient actions to restore island ecosystems. Most projects have been carried out in temperate regions; increasing the effort on tropical islands is crucial as the region includes high numbers of threatened species, including iguanas. Eradication of rats from islands can only be achieved using rodenticide toxins. However, the non-target consequences and the fate of toxicant residue from such operations have not been well explored. Alongside three rat eradications on Mexican tropical islands (2009-2015), we conducted research on native iguanas and implemented captive programs in order to: 1) minimize the potential primary and secondary poisoning on iguanas; and 2) better understand bait palatability and susceptibility on three iguana species (*Ctenosaura pectinata*, *C. similis*, and *Iguana iguana*). Bait palatability varied among individuals; bait consumption during the eradications was higher than during trials. Temporary captivity of commensal iguanas (four to six weeks) was a successful approach to minimize the risk of poisoning. Nevertheless, in the absence of such commensal behavior, captivity measures may not be necessary as long as iguana populations are healthy. Very low mortality was recorded among wild iguanas exposed to bait, which suggests low susceptibility. More research on other iguana species is urgently needed, especially on islands where rodent eradication projects may take place in the coming future.

## **St. Eustatius' Iguana Population: Pure *Iguana delicatissima*, but Genetically Depleted**

van den Burg, Thijs\*<sup>1</sup>, Mark Welch<sup>2</sup>, Hannah Madden<sup>3</sup>, Bart Kluskens<sup>4</sup>, Hans Breeuwer<sup>1</sup>, and Patrick Meirmans<sup>1</sup>

<sup>1</sup>University of Amsterdam, Amsterdam, the Netherlands; <sup>2</sup>Mississippi State University, Starkville, Mississippi, USA; <sup>3</sup>Ecological Professionals Foundation, St. Eustatius; <sup>4</sup>WIL Research Europe, Den Bosch, the Netherlands

The Lesser Antillean Iguana (*Iguana delicatissima*) is an Endangered species that is threatened by habitat loss and hybridization with the invasive Common Green Iguana (*Iguana iguana*). *I. delicatissima* has been extirpated on several islands and only a few populations remain that have not yet been invaded by the Green Iguana. Information about these last remaining strongholds is essential to protect this species from extinction. Focussing on St. Eustatius, we caught nearly 80% of the known population and used genetic data to assess our research questions. We test if hybridization with the Green Iguana historically and/or currently occurs using mitochondrial and nuclear gene RFLPs. Data from 16 microsatellite loci is analyzed to determine genetic diversity, population structure, and effective population size. Molecular and morphological data were consistent, indicating all captured iguanas as pure *I. delicatissima*. However, compared to populations on Dominica and Chancel, extremely low levels of genetic diversity were found on St. Eustatius ( $H_E=0.057$ ). This indicates that this population is genetically depleted, probably caused by several bottleneck events. Furthermore, there is significant evidence for inbreeding ( $F_{IS}=0.115$ ) and weak structure ( $F_{ST}=0.019$ ) within this population. Although free from hybridization, this population's low genetic diversity and low levels of recruitment could indicate that it suffers from inbreeding depression that threatens its long-term survival. In addition to this specific project, we will give an outline of ongoing projects and other results from St. Eustatius.

## **An Update on the Jamaican Iguana Recovery Program – Status in the Hellshire Hills and an Evaluation of Portland Ridge for Reintroduction**

van Veen, Rick<sup>1\*</sup>, Damion Whyte<sup>1</sup>, Stesha Pasachnik<sup>2\*</sup>, and Eric Garraway<sup>1</sup>

<sup>1</sup>Department of Life Sciences, The University of the West Indies, Mona Campus, Kingston, Jamaica; <sup>2</sup>Fort Worth Zoo, Fort Worth, Texas, USA

The Jamaican Iguana Recovery Program was implemented following the rediscovery of the endemic Jamaican Rock Iguana (*Cyclura collei*) in 1990, within the dry limestone forest of Hellshire Hills. This program consists of nest monitoring, headstarting, and invasive species control to ensure the survival of the species. In addition, intensive research has focused on adult and hatchling distribution, and survival. However, given the amplitude of threats to the Hellshire Hills, one objective was to establish a population in an alternate location. The Goat Islands were selected for this effort given that the major threats could be more easily controlled on these small islands. However, these islands have recently been considered as part of a major port development project. An additional location, Portland Ridge, is also being

considered as a possible site for introduction efforts. The Portland Ridge dry limestone forest is comparable to Hellshire Hills and remains in relatively good condition, due to private citizen protection. The area is owned by the Jamaican Government and leased to two local gun clubs. Both clubs have utilized the area for bird shooting, which has played an important role in the protection of the forest against excessive human activity. Preliminary surveys to identify areas in Portland Ridge which possess vital resources, similar to those of the Hellshire Hills, are ongoing. The objectives are to compare nesting and retreat sites, as well as optimal food availability. Additionally, an assessment of existing invasive species is being conducted. Preliminary results suggest that the habitat should provide ample dietary resources, and nesting and retreat sites. However, invasive mongoose, goats, cats, dogs, and pigs will need to be eliminated from the area prior to proceeding with the reintroduction program. Intensive control efforts coupled with an exclusion fence are currently being considered and discussed with the gun clubs.

### **Removal and Management of a Population of Common Green Iguanas (*Iguana iguana*) from a Bahamian Island**

Wasilewski, Joseph\*, Edward Metzger, and Nick Wasilewski

Natural Selections of South Florida, Inc., Princeton, Florida, USA

Cat Cay, The Bahamas, is a privately-held island belonging to the Commonwealth of The Bahamas and managed by a USA-based company. The island is approximately 8 km south of Bimini, The Bahamas. The island is 3 km long, 1 km at its widest, but the majority is 200 m wide. It has a total of 50 homes which are eloquently landscaped and maintained, most being second homes for part time residents. A 9-hole golf course takes up approximately 20 ha with a saline lake in the center. The golf course is bordered on all sides by tropical hammocks comprised of natural Bahamian vegetation along with some exotics. The island has two native anoles and zero native iguana species.

In approximately 2004, some entity released a pair of Common Green Iguanas (*Iguana iguana*) on the cay. They remained unencumbered until September 2014 when Joseph Wasilewski was asked to travel to the island and assess the population. At that time, it was determined the island had an over-abundance of Green Iguanas. Since September 2014, the staff of Natural Selections has traveled to Cat Cay ten times for a total of 30 days. To date, 7,690 iguanas have been removed (captured, processed, and disposed of) from the island. Snout-to-vent length, weight, and sex was recorded for each iguana removed. During the winter and spring months, adult female iguanas were checked as to their fecundity. To date, 1,321.4 kg of Green Iguanas have been removed from the island and the Natural Selections team is on pace for managing the population. However, due to the amount and type of vegetation on the island (approximately 50,000 coconut trees), the iguanas will most likely never be completely removed and will always require management. This is an active project expected to continue into the next year or two.

## **Assessing the Effects of Tourism and Food Provisioning on Physiological Systems Critical to Self-maintenance and Survival of Exuma Rock Iguanas (*Cyclura cyclura*) in The Bahamas**

Webb, Alison<sup>1</sup>, Charles Knapp\*<sup>2</sup>, Dale DeNardo<sup>3</sup>, John Iverson<sup>4</sup>, and Susannah French<sup>1</sup>

<sup>1</sup>Department of Biology, Utah State University, Logan, Utah, USA; <sup>2</sup>Daniel P. Haerther Center for Conservation and Research, John G. Shedd Aquarium, Chicago, Illinois, USA; <sup>3</sup>Department of Animal Care and Technologies, Arizona State University, Tempe, Arizona, USA; <sup>4</sup>Department of Biology, Earlham College, Richmond, Indiana, USA

Ecotourism potentially contributes to wildlife conservation by facilitating positive attitudes toward conservation, garnering financial support for programs, and providing economic opportunities to local stakeholders. These potential benefits to wildlife, however, are realized only when benefits outweigh costs to population health and survival. An increasingly popular ecotourism activity in The Bahamas includes feeding atypical or inappropriate food items to endangered Rock Iguanas (*Cyclura cyclura*) inhabiting the Exuma Islands. Past research has demonstrated that daily island visits can cause behavioral changes, unnaturally high densities at primary landing beaches where iguanas are fed, higher endoparasitic infection rates, and differences in indicators of dietary nutrition such as glucose, potassium, and uric acid. Despite these alterations, it is currently unclear what long-term fitness costs are incurred in natural populations. Because ecotourism in The Bahamas and throughout the Caribbean will likely continue to increase, we expanded the scope of previous research by exploring physiological systems critical to self-maintenance and survival as indicators for overall population health of Exuma Rock Iguanas in The Bahamas. Here we report differences in oxidative stress responses between visited and non-visited iguana populations. We also report how oxidative stress varies among three sampling periods throughout the year, and with clutch size in females. We anticipate that our field protocols and data from this study can be used to rapidly assess population health for endangered iguanas impacted by humans throughout the Neotropics.

## POSTER PRESENTATION ABSTRACTS

In alphabetical order by submitter's last name

### **The Diet of Feral Cats (*Felis catus* L.) in Cabritos Island in the Dominican Republic**

De la Rosa, Víctor I.<sup>1</sup>, and Rosanna Carreras De León<sup>1</sup>

\*Presented by Stesha Pasachnik, Fort Worth Zoo, Texas, USA

<sup>1</sup>Área de Ciencias Básicas y Ambientales, Instituto Tecnológico de Santo Domingo (INTEC), Santo Domingo, República Dominicana

*Felis catus* is among the most widespread invasive species and is known to be a successful invader causing negative impacts on native wildlife. Introduced domestic animals compete with iguanas for resources, or in the case of cats, prey on young individuals. Collectively, they constitute a direct threat to the survival of these endangered animals. In 2012, a project to remove invasive species within Cabritos Island was implemented and completed in 2016. *Felis catus* individuals were captured in 2012, 2013, and 2015 on Cabritos Island during the eradication project. Stomach content was stored in 70% ethanol until analysis. The results were analyzed in two different ways: we estimated the frequency of occurrence and the Index of Relative Importance (IRI) for each food item found in the diet. A total of 41 cats were capture for this study. Prey items were organized by family in 17 food items. The three most important food items in the cat diet were: Muridae, Leiocephalidae, and Iguanidae. Overall, mammals and reptiles were the two most common prey for cats on Cabritos Island.

### **Monitoring an Endangered Iguana and Cultivating the Next Generation of Researchers and Managers**

Goode, Ashley<sup>1</sup> and Stesha Pasachnik\*<sup>2</sup>

<sup>1</sup>Flamingo Gardens Wildlife Sanctuary, Davie, Florida, USA; <sup>2</sup>Fort Worth Zoo, Fort Worth, Texas, USA

*Ctenosaura oedirhina* is severely threatened outside of grassroots protected areas, on Roatán, Honduras, and population densities are decreasing. In order to ensure the long-term survival of this species, it is vital that its populations are continually monitored and a visible presence is maintained on the island. The present approach for this project is to collect long-term demographic data while training small groups of individuals from iguana range countries, to be local conservation leaders. Holding twice yearly workshops allows us to work with a greater number of individuals while holding to our small group model. The timing of these workshops also allows us to compare demographic data across years as well as be present during portions of the nesting and hatching seasons. Our workshops are ten days and focus on various field techniques as well as broader conservation concepts, all of which can be applied to a variety of species. Workshop participants gain experience in capture, processing, marking, DNA sample collection, survey techniques, data input, and basic data analysis through a combination of

lectures and hands-on experiences. Through the application process we gain information on the participants' experience level and interests such that we are able to cater each workshop to their specific needs and concentrations. Roatán is an ideal location for these workshops. Not only is continued work with this species vital, but several of our study sites have ample iguanas, such that iguana captures for training are guaranteed. Participants leave with a better appreciation for and understanding of conservation research and have the practical skills necessary for conducting their own monitoring and research programs. Data collected during these workshops also allows us to monitor population trends over time and adaptively manage this species.

### **Conservation in Action: A Grass Roots Project to Save Utila's Endemic Iguana**

Maryon, Daisy\*<sup>1,2</sup>, Holly Black<sup>1</sup>, Ashley Zubeck<sup>1</sup>, Andrea Albergoni<sup>1</sup>, Tom Brown<sup>1</sup>, Steven Clayton<sup>1</sup>, Andrea Martinez<sup>1</sup>, Flavia Diotallevi<sup>2</sup>, Marisa Sorrell<sup>3</sup>

<sup>1</sup>Kanahau Utila Research and Conservation Facility, Utila, Honduras; <sup>2</sup>University of South Wales, Treforest, Wales, United Kingdom; <sup>3</sup>University of Kent, Canterbury, Kent, United Kingdom

The Critically Endangered iguana *Ctenosaura bakeri* is endemic to the island of Utila, Honduras. It inhabits mangrove forest and nests on sandy beaches. Threats to this species include habitat destruction, hunting, an apparent male-biased sex ratio (possibly due to hunters targeting gravid females) and hybridization with *Ctenosaura similis*, another iguana species on the island. Kanahau Utila Research and Conservation Facility is run by a small team of scientists and hosts volunteers and researchers to study *C. bakeri* and the other flora and fauna of the island. We also run an environmental education program in local schools in conjunction with two other NGOs (Bay Island Conservation Association and Whale Shark Oceanic Research Centre). Regarding the iguanas, we conduct a number of ongoing studies to assess the population and ecology of this species, and the significance of the threats to its survival. Population size, habitat use, and breeding migration is studied using line transects, capture mark-recapture and radio-telemetry. Habitat surveys of located nest sites are carried out to assess nesting requirements, and hatchlings are captured and sexed using cloacal probing to investigate any sex ratio skew from birth. DNA samples are collected from individuals of both species to determine whether hybridization is occurring and to what extent. Surveys of both local people and tourists aim to determine the level of awareness of *C. bakeri* and its Critically Endangered status, as well as investigate the extent of hunting. Data collected is used in the IUCN Red List assessment for *C. bakeri*, and in the longer-term will be used to advise protection plans for the species and its habitat, including control of development and improved enforcement of legislation. Future work will include further investigation of hunting pressures, study of dietary requirements, and expansion of the environmental education program.



## 2016 IUCN SSC Iguana Specialist Group Annual Meeting

Musket Cove Island Resort and Marina,  
Malolo Lailai, Fiji

### MINUTES

*Special thanks to note takers: Adam Clause, Flavia Diotallevi, Daisy Maryon, and Thijs van den Burg.*

#### Day 1: 1 November 2016

**9:00** Welcome and self-introductions — (Chuck Knapp and Stesha Pasachnik)

**9:15** Opening Welcoming and Address — (Mason Smith and Joshua Wycliffe)

**9:30** Vote of Thanks

**9:45** Information about venue and surrounding area (Robert Fisher and Kim Lovich)

**1. Nesting Ecology of *Cyclura nubila caymanensis* on Little Cayman** (Moss, Jeanette, Glenn Gerber\*, Mark Welch, and Jessica Harvey)

- Question: Is there a natural reduction of predators on the island? Answer: It's a pretty undisturbed site. Cats are a huge problem together with roadkill. Nesting occurs in coastal areas and with reforestation taking place the sites are becoming more shaded and less optimal for nesting.
- Question: Is roadkill island-wide? Answer: It is worse on the west but it's more widespread now. There is a program in place on the island because the iguanas are the focal point of conservation.
- Question: Do you think it is possible that someone has been moving the hatchlings across the island? Answer: Probably not because they bite and scratch.
- Question: Was there much difference in success rate of hatchlings between the deeper nests? Answer: No difference in hatching success: they were just cooler so incubated longer.

**2. An Update on the Jamaican Iguana Recovery Program – Status in the Hellshire Hills and an Evaluation of Portland Ridge for Reintroduction** (Rick van Veen\*, Damion Whyte, Stesha Pasachnik\*, and Eric Garraway)

- Question: Where are the gun clubs and what do they do? Answer: They have a 6-week shooting period every year, shooting game birds (6 species) with a limited number allowed per person per year. But it's mostly done by the older generation; younger members just spend time at the lodge. They are now considering a future that preserves the wildness of the Ridge.
- Question: Have you approached the gun clubs for help with predator control? Do they shoot pigs as well? Answer: It is possible but not done yet; they might be interested in shooting mongooses because they affect the bird population too.
- Question: What is the involvement of US Fish and Wildlife Service? Answer: The IIF has received funding from them for this program.

**3. On-going Research and Monitoring of the Repatriated and Translocated Subpopulation of the Sandy Cay Rock Iguana *Cyclura rileyi cristata* in the Moriah Harbour Cay National Park, Exuma** (Sandra Buckner, Jill M. Jollay\*, John B. Iverson, Shannan S. Yates, and Susannah S. French)

- Question: What is the size of the island? Answer: 7 hectares.
- Question: Did you ultrasound any of the animals? Answer: Only a few and confirmed the probing as males.
- Question: Any signs of hatchlings? Answer: One was possibly sighted.
- Question: Is the island restricted? Answer: It is a national park but anyone can access it. There are no restrictions but we're considering monitoring movements by installing security cameras and signage. Dogs or cats should not be allowed on the island.
- Question: Is sexual dimorphism related to incubation temperature? Are there other species with such skewed sex ratios as these iguanas? Answer: No, temperature does not affect the sex of hatchlings, and no there is no known skewness among other populations. We are looking into sexing by DNA as the next step.

**4. A Study on the Natural History, Demography, and Dispersal Behavior of the Critically Endangered Island Endemic, Uta Spiny-tailed Iguana, *Ctenosaura bakeri*** (Daisy Maryon\*, David C. Lee, Stesha A. Pasachnik, and Steven Clayson)

- Question: Are boa constrictors native? Answer: Yes.
- Question: How much of the island is owned privately? Answer: All of the island is divided in plots, and all owned privately.
- Question: Did you have many difficulties in radiotracking? Answer: Spent a lot of time hunting for them, they are difficult to see, some tags came off.
- Question: How do you tag the hatchlings? Answer: Toe clips for hatchlings.
- Question: What is the population estimate? Answer: I think it is near the low end of what has been quoted, so closer to 3000.

**5. Nesting Ecology and Habitat Temporal Change Analysis of the Critically Endangered *Ctenosaura bakeri*** (Diotalleivi, Flavia\*, David C. Lee, Malcolm Thomas, Daisy Maryon, Stesha Pasachnik, and Steven Clayson)

- Question: Do you have a lot of collaboration with locals? Answer: We are beginning to work with school kids. Daisy added that the police eat confiscated iguanas.
  - Question: Is there a difference in the nest sites for the hybrids and the pure iguanas. Answer: At this point, we are not sure which are hybrids' sites yet.
  - Question: Do *similis* nest at different times of year? Answer: No, we found *similis* hatchlings inside the *bakeri* plots, so they overlap.
- There were several questions about the sale of private lands in or out of the mangrove areas. Stesha noted that it is not illegal to buy mangrove land, but it is illegal to develop it.

**6. Effects of Habitat Fragmentation in the Genetic Variation of *Ctenosaura oxacana*** (Carmina Martinez-Gonzales\* and Víctor Hugo Reynoso-Rosales)

- Question: How big is that hatchling in your photo? Answer: That's a 2-day old hatchling, <5 cm.

**7. An Update on the Work of Zootropic with *Ctenosaura palearis* in the Valle de Motagua Guatemala** (Daniel Ariano and Johana Gil, presented by Stesha Pasachnik)

- Question: Were the seeds in the study always extracted from the scat? Answer: Yes.
- Question: Does the extraction process of the iguanas from their holes injure the trees? Answer: Yes, but in most cases the trees are dead already.
- Question: Would results be different if you used soil instead of scat? Answer: Possibly.

**8. Distribution and Abundance of *Sauromalus hispidus* in the Islands of Baja California** (Victor Reynoso\*, Eugenia Zarza, Nancy Gabriela Santos Hernández, Carmina Martínez-González, María José Monteverde-Suarez, Yssel Gadar Aguayo, Ángel Bernardo Villarreal Medina, and Román Becerra Reynoso)

- Question: Have you noticed dimorphism in the iguanas between the islands? Answer: On some islands, they are smaller possibly due to resources.
- Question: Is anybody studying the natural history of *Sauromalus*? Answer: Yes, especially in terms of seed dispersal.
- Question: When did you do your surveys? Answer: Summer, because they won't come out unless it's very hot.
- Question: Are there historical records on the islands where you didn't find any? Answer: Yes.
- Question: Are there introduced cats on the islands? Answer: Yes, most likely.
- Question: Can you tell from the carcasses the causes of death? Answer: Yes, mostly, some of the found animals died of natural causes (and dehydrated) but in some cases it's evident that they were predated.
- Question: Do you think there has been an overall decline in the last 20 years? Answer: Yes, there has been some decline.

**9. St. Eustatius' Iguana Population: Pure *Iguana delicatissima*, but Genetically Depleted** (Thijs van den Burg\*, Mark Welch, Hannah Madden, Bart Kluskens, Hans Breeuwer, and Patrick Meirmans)

- Question: Is the allelic diversity you are reporting a small subset? Answer: Yes, as we didn't have samples from Dominica yet and there could be more alleles in that population.
- Question: What genetic method did you use to assess hybridization? Answer: I have not looked at that study.
- Question: Did you have samples from the late 90s? Answer: Yes.

**10. Minimizing Non-target Impacts on Native Iguanas in Island Rodent Eradications in the Tropics** (Araceli Samaniego-Herrera\*)

- Question: Did you do any toxicology analysis? Answer: No.
- Question: Is it possible that the poison would get washed in the sea and affect fish? Answer: No, very little, it's made sure that the poison is dispersed on the island only with special deflecting baffles.
- Question: Have there been any studies done beyond first generation impact? Answer: Second generation is more at risk; the risk also comes from the accumulation of poison pellets.
- Question: Who sets priority on which islands to be eradicated? Answer: It's complicated. Depends on a number of factors such as the isolation of the locations and the ease of return of the pest rats.

**11. Assessing the Effects of Tourism and Food Provisioning on Physiological Systems Critical to Self-maintenance and Survival of Exuma Rock Iguanas (*Cyclura cyclura*) in The Bahamas** (Alison Webb, Charles Knapp\*, Dale DeNardo, John Iverson, and Susannah French)

- Question: Are there tours that take people out just to take pictures instead of feeding? Answer: No, they all go there to feed the iguanas.
- Question: Shift in the food: have you considered providing better food? Answer: Yes, we have provided and suggested better ways of feeding them, like using skewers.
- Question: Regarding the fecal analysis. Answer: We collected samples from different sites.
- Question: How much do the tour operators charge? Are there any populations that they have stopped feeding? Answer: They charge \$100 for the tour and we don't know if this money goes toward conservation. There is one population that they stopped feeding because operations were moved to another island.

- Question: Is it legal to feed the iguanas? Answer: There is no law against it and you can't actually forbid it. The tour operators were upset by the markings we made on the iguanas, so we now mark them with little dots.
- Question: Are there reports of aggressiveness? Answer: Feeding can lead to larger animals but on some islands we noticed that the large animals were disappearing. We suspect that large animals are removed by tour operators because they may become aggressive/intimidating to tourists as they rush for food.
- Question: Is the high level of glucose intake a threat? Answer: It was observed that non-fed populations could assimilate glucose much better than the fed ones.
- Question: What happens in the weeks when there is high fruit availability naturally? Answer: Iguanas that are accustomed to daily feeds will default to the tourist-fed diets, though they may supplement their diets with fruit close to the beach.
- Question: Is there seasonality in the touring? Answer: There used to be in the past but it's no longer the case, and tours are weather-dependent but occur year-round.
- Question: Have there been direct efforts to train operators? Answer: They are receptive to suggestions but more needs to be done.

### **Day 2: 2 November 2016**

**9:00 Daily agenda review, meeting logistics update** — (Chuck Knapp, Stesha Pasachnik, Robert Fisher, Kim Lovich)

#### **12. Biosecurity Authority of Fiji Mandate and Current Work on Invasives, Including Green Iguanas in Fiji** (Jainesh Ram\* and Monika Devi\*)

There are ~2,500 American Iguanas (*Iguana iguana*) estimated now from the islands of Laucala, Matagi, Taveuni, and Qamea. In 2014, an Action Plan was developed by Biosecurity Authority Fiji (BAF) following recommendations from ISG scientists. In early 2015, BAF began a collaboration with Fiji Military forces to help with eradication, and troops were deployed to Qamea. There is a need for transparency in collaborations. BAF is excited to continue collaborations with scientists to inform control efforts for *Iguana iguana* in Fiji.

- Question: What is the introduction source and how were they introduced? Answer: They were introduced by one American to Qamea in 2000.
- Question: How many Green Iguanas were originally introduced? Answer: We don't know.
- Question: How many Green Iguanas are left after the control efforts? Answer: The numbers decreased, but less than 100 are captured/killed per year.
- Question: Are mongoose on the islands? Answer: Most of the islands inhabited by Green Iguanas do not have mongoose.
- Question: How did the Green Iguanas disperse across the multiple islands? Any evidence of human-mediated dispersal or human consumption? Answer: There is anecdotal evidence of human dispersal, but more likely iguanas dispersed by swimming. We are unaware of human consumption of iguanas.
- Question: Is there a plan for on-the-ground communication with local residents to inform them of the removal project? Answer: Yes, BAF is in the process of employing new officers for deployment to the islands.
- Question: How many military were deployed, and how many iguanas were removed? Answer: About 120 military personnel were deployed, but no idea how many iguanas the military actually removed.

- Question: Is there an educational campaign to inform the general public about the detrimental effect of Green Iguanas? Answer: Some work is ongoing.
- Question: Any deadlines for eradication? Answer: None as yet, because control efforts are ongoing.
- Question: What has happened to the iguana control officer on Qamea? Answer: It is unclear.
- Question: What is the status of punitive measures against the original introducer of the Green Iguanas? Answer: No punitive measure is ongoing, because of lack of direct observation or photographic evidence of law-breaking. The alleged offenders have also threatened countersuits should charges be brought against them, and they are wealthy.

### **13. Management Actions on Grand Cayman: Controlling Green Iguana Overabundance** (Jane Haakonsson\*, Jessica Harvey, and Frank Rivera-Milán)

- Question: Is it possible that hunters might try to breed Green Iguanas in order to continue making a profit from removal? Answer: The short duration (1 week) of culling was intended to prevent hunters from considering this removal effort to be a long-term source of income (unlike, say, a bounty).
- Question: How many islands in the Caymans support Green Iguanas currently? Answer: All three, but other Caribbean islands are experiencing the same problems with this invasive species, so the issues discussed are of widespread relevance.
- Question: Seems like a hopeless case. What will be done besides monitoring? Answer: The Cayman government has an environmental fund, and fund allocation is dependent on the severity of the threat being addressed. Because the Green Iguanas are such a huge problem, currently there is a great deal of funding support, but long-term there is recognition that this expensive control initiative likely cannot be repeated due to monetary constraints. Exploration of alternative approaches is ongoing.
- Question: Could sterilization of males or genetic methods be used to control these iguanas? Answer: Despite the simplicity of the sterilization procedure in Green Iguanas, it is not currently feasible for a population of Greens this large and occurring over such a large area.
- Comment by Phil Andreozzi: Male sterilization is a technique mostly applied with success in insects. Ultimately, the Grand Cayman case study emphasizes the need for preventing introductions, and the need for immediate eradication efforts before widespread establishment occurs.
- Comment from Bonnie Raphael: Male sterilization has been used in chelonians (e.g., phallectomy in a Galápagos tortoise species), so it might be a viable option to consider in some iguana examples, along with nest destruction efforts. Potential application of this technique to lizards may be worth further investigation.

### **14. Invasive Species Efforts in the Pacific—A View from 40,000 Feet and Opportunities for Green Iguana Efforts in Fiji** (Phil Andreozzi\*)

- Question: Invasive control efforts can seem like a never-ending process. Is there a way to simplify the process or make it more efficient? Answer: The key is to stop the species from establishing in the first place, or control/eradicate immediately upon detection.
- Comment from Rob Fisher: There is a new book recently released called “Isles of Amnesia”, which covers Pacific control efforts for invasive species.
- Comment from Chuck Knapp: Iguana biologists need to be aware of personal biosecurity as well. Inter-island seed transport is a concern. Consider an ongoing case study of ticks in The Bahamas — iguana ticks are found on some islands, but not others. Iguana biologists need to prevent spread of ticks on cloth collecting bags (bleach bags between islands).

### **15. Wildlife Services in the Pacific Theater (Rob Gosnell\*)**

- Question: Are the helicopter dropped bait-mice dead? Answer: For the aerial bait drops (mice containing aspirin), the mice are dead when deployed.
- Question: Do you use electric fences around airports or other areas at high risk for point-source inter-island snake transport? Answer: No, the fence is not electrified, but physically there is a modification to the fence that prevents snakes from easily climbing it.
- Question: Has the aspirin been tested as a poison for Green Iguanas? Answer: No, but it may be worth investigating because it is relatively cost-effective. Pre-monitoring probably costs the most.
- Comment from Phil Andreozzi: Note that the control being done has no effect on the Brown Tree Snake's population on Guam, but it is highly effective at preventing inter-island spread of the snake, which is hugely important for regional invasive species control.
- Question: Are the patrol dogs looking only for Brown Tree Snakes? Answer: Yes, they are specifically trained for snake detection. Training is highly flexible, however, and could be used to detect iguanas or iguana nests, for example.

### **16. Hybridization: A New Threat from Invasive Green Iguanas (*Iguana iguana*) to the Endemic Sister Islands Rock Iguana (*Cyclura nubila caymanensis*) of Little Cayman (Edward Houlcroft and Michael Vallee\*)**

- Question: What steps has Little Cayman taken in terms of biosecurity? Answer: Biosecurity is currently a big problem because no agency or group has taken responsibility for it. The island has one private port, managed by one shipping company, so biosecurity should be logistically feasible. But the shipping company will have to allow government officials to access their property and maintain a fence, etc. There is little sense of the company's support for a self-funded biosecurity of that port; so funding must come from the government. Historically, there was local controversy about the way that Green Iguanas were entering Little Cayman, but now we know they are entering via this port, so focus must be on closing this entry point to iguanas. There is poor official monitoring currently. The Government must take a leading role, and enforcement is paramount for success.

### **17. Removal and Management of a Population of Green Iguanas (*Iguana iguana*) from a Bahamian Island (Joseph Wasilewski\*, Edward Metzger, and Nick Wasilewski)**

- Question: Is the Green Iguana population starting to exceed their food supply? Answer: With the ongoing removal efforts, not likely. Some hard-hit ornamental plantings have already begun to recover following the ongoing control of Green Iguanas.
- Question: How supportive are local island residents to iguana control? Answer: 100% of residents (about 50 homes) are supportive of the iguana control efforts.
- Question: Perhaps eradication may actually be possible on this cay? Answer: Yes, but it all depends on the amount of funding and time that can be devoted to it.
- Question: Are residents willing to spend money on iguana control? Answer: Yes, but their elasticity in funding remains to be determined.
- Question: What about constructing artificial nesting sites? Answer: Yes, it was considered, and it seems to be effective in Florida. We now know where the iguanas nest on this island, and can begin to target those existing nest sites to destroy eggs. There isn't a real need to make artificial sites to concentrate the iguanas here.
- Question: Are there any native snakes on the island? Answer: No, all snakes present on the island are non-native.

## **Invasive Iguana Discussion (All)**

A discussion was opened about a Puerto Rico program just started that is packaging and selling Green Iguana meat for food. A big problem in the Cayman Islands with marketing culled iguanas as meat is that nobody wants to start a business where the entire objective is to put oneself out of business through eradication. Local sea turtles are still processed legally in the Cayman Islands. A few private entrepreneurs tried to market Lionfish for sale, but it never really got off the ground because of low profitability and people lost interest.

Creating incentives for invasive removal can lead to counterproductive effects, where people link the animal to a monetary incentive and then actually spread them to new areas, ultimately exacerbating the problem. An example of this is Catfish.

Asian Carp incentives is one example of marketing for the removal of invasives, but this has been implemented because there are absolutely no other options on the table.

Reiteration from Phil Andreozzi that by marketing iguanas for meat, there could be severe unintended consequences and you need to think of all the potential implications.

Discussion between Joe Burgess and Phil Andreozzi concerning the topic: Is Green Iguana eradication even a possibility to consider at this stage? Perhaps on a small island (such as the example discussed by Joe Wasilewski), but on the vast majority of islands, eradication is simply not logistically feasible once the invasive iguanas gain a solid foothold. Joe Wasilewski's island has private ownership interest and a good case study, but does not have conservation value to benefit other iguana species.

Araceli's presentation described baiting for mammals, perhaps there are bait options for iguanas. The development of such a product could be beneficial. However, the bait must be more attractive than ambient food resources to be effective. Some felt that iguanas are not easily baited, particularly on large islands where there is plenty of natural food, no matter the season. A mention was made of pheromone testing on snakes in the Canaries – perhaps iguanas can be attracted to bait using male femoral pore secretions.

Distinction must be made between eradication and control, but eradication could be possible with a very rapid response once the first colonizers are detected. Control efforts could also have the added benefit by reducing the possible spread of iguana propagules to other nearby islands.

Is there a middle ground, where instead of talking about eradication, we talk about control to the point of an invasive iguana population being no longer ecologically harmful due to severe population reduction?

There is value in having some sort of widely-accepted standard for declaring eradication efforts successful. Need a proven survey method, but will probably have to be adaptable for different global situations. Skepticism of claims of eradication can be an issue to the legitimacy of claimed eradications. Need a long-term follow up commitment to re-survey and really determine if eradication has been achieved.

The vast majority of the work in an eradication comes in capturing the last remaining 5% or so of the population. As such, control may be more feasible and lead to some substantial bang for the buck.

The island discussed by Joe Wasilewski in his earlier presentation may be an excellent "living laboratory" to test out innovative iguana control techniques. We should have a document cataloging all the methods that have been used and results.

With respect to Brown Tree Snakes on Guam, hopefully we will eventually develop tools that could allow for eradication of the snakes there. But the simple act of control at ports of entry/exit is huge right now. This is a vital first step to help keep the problem from worsening regionally, until eradication techniques can eventually be developed. Let's stay innovative, think outside the box, and continue to investigate possible options for future eradication technology.

Big picture, perhaps we need to forge more partnerships and be proactive about involving appropriate people and stakeholders (such as biosecurity authorities, perhaps cruiselines) to address these problems. As a group we need to keep these ideas at the forefront for our group and get outside help.

Also important to take the right statistical approach that integrates occupancy and detectability to produce scientifically rigorous estimates of how bad the problem is, in terms of population size of invasive iguanas. The analysis of Greens on Grand Cayman is a good example.

Is it possible to encourage people to harvest an iguana from an occupied island while dissuading them from spreading the animals elsewhere? The threat of spreading iguanas is huge. Hybrids between *Cyclura* and *Iguana* suggest that the threat of *Iguana iguana* in Fiji is even greater than currently believed, because they may actually be capable of hybridizing with *Brachylophus*. The problem of creating an industry around iguana harvest is a very difficult problem, and must be considered very carefully.

We have to think about tradeoffs between shifting a community from subsistence agriculture to subsistence harvesting of iguanas in a low-resource developing economy like many remote Fijian villages. If we promote eating them, we could be concerned with eating native iguanas or trying to farm the Greens.

Some agreement that the problem with the *Iguana iguana* in Fiji is an urgent problem, and that eradication/control in the Taveuni area is a huge priority. This strategy is perhaps best viewed using a different lens than that applied to invasive iguana measures in the Caribbean, where the situation is far more advanced along the invasion timeline. We need to put everything into the problem in Fiji while it is still contained and possible. Look for nesting sites in particular, with our knowledge of nest conditions. It is in the U.S.' best interest to help with this eradication before it gets to U.S. territories.

Opposing opinion expressed that eradication of invasive iguanas in Fiji is already impossible. For example, Taveuni is far too large and rugged for eradication under existing methodologies. It is believed that no one has yet looked for nest sites.

Rejoinder that even if we do not pursue full eradication from Taveuni, let's consider control analogous to Brown Tree Snakes in Guam. If the broader Pacific region recognizes the negative impacts of invasive iguanas spreading to other Pacific countries, then broader deep-pocket funds can open up and be brought to bear on the Fijian problem. Tie it into climate resilience, food security, etc.

Concluding thoughts to expand the discussion into a breakout group.



A sign posted at the ferry landing at Vanua Levu.

### **Iguana Smuggling Discussion (All)**

A presentation was given regarding smuggling activity and suspected persons. *Censored, contact Tandora Grant for notes.* A discussion followed.

Robert Fisher, Kim Lovich, and Jone Niukula have checked all of the CITES records. Iguanas have never been legally exported from Fiji, globally. Those who claim to have CITES paperwork justifying their possession of *Brachylophus* overseas are not legitimate.

In the most recent CITES Conference of the Parties (COP) meeting, it was voted to enforce CITES restrictions against captive-bred offspring of illegal parent stock for CITES-listed species, such that those offspring are no longer exempt.

Why is it not allowed to bring cameras into The Hamm, the annual reptile show in Germany where many illicit reptiles are sold? Why is this not more transparent and open, when we know illegal dealings are happening there? Baby *Brachylophus* iguanas sell for ~1,000 Euros, for example.

Law enforcement may not take smuggling of reptiles seriously, and former offenders are often brazen about their former illegal activities after having served their time.

Smuggling activities may now have gone “underground”, and so are very difficult to track and prosecute, contributing in part to the general lack of law enforcement.

CITES has set up a task force to deal with many of the issues related to wildlife trafficking of protected species, involving local CITES management authorities, and others.

### **Update about CITES Proposal to List Genus *Ctenosaura* (Víctor Hugo Reynoso)**

Víctor has been working to list *Ctenosaura* under CITES, and the proposal was presented to the Mexican authorities. Trade in *Ctenosaura* is happening. Some people did not support the idea of listing the entire genus. Hoping for some help in moving forward with re-submission of the proposal.

Future steps, we now have three years to fix issues and re-submit the proposal. CONABIO and SEMARNAT in México need to see stakeholder agreements on the proposal to list *Ctenosaura*. There was a frustrating change of heart among some folks to no longer support the proposal. Víctor will continue to document airport trade, because no legal trade in *Ctenosaura* is allowed in Mexico.

For a genus-wide proposal, all countries that have *Ctenosaura* populations have to be supportive of the proposal.

- Question: What is the approach of the proposal? Are you describing the threats and biology of one species, and then adding on all the other species as “look-alikes?”
- Question: Are the people blocking this in México worried that a CITES listing will somehow “greenlight” legal trade in some areas? Víctor’s reply is that legal trade is already happening, for instance in *Abronia*, or *Claudius angustatus*, CITES proposals that had successfully passed. Perhaps politics are involved in the surprising rejection of the proposal.

### **Genetics Working Group Updates (Catherine Malone and Stesha Pasachnik)**

There are 41 genetics projects active or in some stage of publishing. Our group keeps a summary document of these projects in order to foster communication and resource sharing amongst geneticists. It also helps us avoid overlap between projects and maximize our efforts. Furthermore, the document allows researchers to identify collaboration opportunities and highlight gaps in effort across the diverse iguanid group of species. Because this document is public, we hope it will serve to encourage new participants to engage in ISG work.

Another very important function of this document is that it connects the non-geneticists to the geneticists. The majority of blood samples obtained are hard-earned in the field, and volunteers on those projects can browse through the document to discover in what ways those samples are being used

(sometimes decades later). Moreover, because the brief summaries focus partly on what questions are being addressed, they can stimulate new ideas and spur conversations between researchers about techniques and analyses, and identify specialists for collaborations.

A quick browsing of the Genetics Summary document reveals a large variety of questions being asked by ISG members within the Genetics Working Group. We are reconstructing evolutionary histories, looking for evidence of hybridization and introgression, and correcting errors in taxonomy. At the species level, geneticists are asking questions surrounding population dynamics and diversity: searching for signals of range expansion or contraction, calculating levels of past and current gene flow between populations, and estimating effective population sizes. Such projects are not only focused on species in their home range, but also where they have become invasive. At a finer scale still, geneticists are measuring levels of inbreeding in wild and captive populations and using such information to guide husbandry efforts. Delving even further are those researchers looking at the genetics of parasites within iguanas.

Some emerging tools are those for use in law enforcement and recovering DNA from fecal samples (which has the potential to tell us both about the animal and its diet). Iguanid geneticists continue to collect traditional DNA sequence and microsatellite data, however, the era of “big data” has reached the ISG. Our labs are generating whole genomes and transcriptomes (both RNA & miRNA), as well as data to profile microbiomes. These types of data allow us to ask more complex questions within topics such as adaptive evolution, gene expression, and even regulation of gene expression. One area of research opportunity is the merging of genetics and physiology. More specifically, investigating how physiological differences can modify gene expression. This line of inquiry has the potential to inform our husbandry best-practices guidelines for producing the healthiest individuals for future populations of iguanas.

### **Update on Iguana Recovery Plans and their Implementation**

Lee Pagni (presented by Tandora Grant)

Handout disseminated arguing for the value of species recovery planning. Seven accounts have historically been prepared by the ISG, mostly from the Caribbean. Much effort is required to put together the workshops to produce these plans, and there is sometimes frustration involved in plan development. An analysis showed that one-third of recovery actions were completed within the timeline, one third were partly completed, and one-third were not completed. However, ancillary benefits to plan development should be considered when deciding whether or not a plan was successful, or a worthwhile effort. For instance, interpersonal connections can be forged through development of the plans. Also, public awareness can be improved through press releases advertising species recovery plan development meetings.

An example was given highlighting the recovery plan development in Grand Cayman that really transformed the recovery of the species. Since the original plan, three recovery plan revisions have been accomplished by in-country partners.

### **ISG Year in Review, Red List Update, ISG Website, New Membership Term 2017–2020, Steering Committee Succession, CITES Permit**

Tandora Grant, Chuck Knapp

This year is our 15<sup>th</sup> year of the ISG newsletter. Tandora is going through each of them, and adding taxon report citations to the Virtual Library. The current issue came out in August, perhaps a bit late, but in part due to integrating annual reports from IIF grantees. Stesha and Tandora created a template to improve IIF grantee understanding of the format and content desired for all annual reports. This template will benefit the grantees, because the report becomes a citable source when added to the newsletter.

Reminder that all ISG members can send emails to the listserv – if you wish to begin a discussion, please do.

Please send Tandora your iguana news to upload to the ISG website. More content is regularly needed. Something as simple as cleaning up an annual report, submitted anyway to regulatory agencies, can be posted on the website and would be great.

After 2.5 years of work, the iguana monograph was published in the journal *Herpetological Conservation & Biology* (HCB). This is the third compilation of iguana manuscripts published. Assembling this volume was an unexpectedly arduous task. Downloads of the article pdfs are tracked by HCB, so please download directly from the site (do not send pdfs to colleagues, send a link to the HCB website for the article of interest). In total, current downloads for individual articles and the entire monograph are ~1,000 downloads. This is actually quite high, relative to other contributions to HCB.

Mark Welch is still the organizer for the blanket CITES *Cyclura* permit for ISG members. The permit renewal has been received by USFWS in October. If permit changes are desired, please send those along, complete with a justification for any proposed changes. Toe-clips, blood samples, and fecal samples are all currently included. Please send all paperwork to Mark Welch in a consolidated, rather than piecemeal, format if possible. The permit covers only *Cyclura*. Robert Fisher has a separate 5-year permit for *Brachylophus*.

During the ISG Steering Committee (SC) meeting last night, enacting term limits was discussed. Nominations and voting on these new SC members will happen soon, perhaps next year. There are seven SC members currently, and we will rotate out two members every three years. Why are the co-chairs not also rotating out? The SC and Chairs are open to re-visiting term limits for the Chairs in the future too. All are in agreement that Co-chairs should not be permanent positions. There is the possibility of staggering the Co-chairs, so that a knowledgeable Co-chair can help a new Co-chair get their feet under them. Please think about who you may want to nominate to the SC. Official nominations will likely happen in the spring, and then the new SC members will be entered in by the next ISG meeting.

People considered “friends” of the ISG can eventually become an official Member of the group. Examples of Member requirements are listed in the latest ISG newsletter, and on the website (About > Members) Active contributions by Members are expected.

### **Next Meeting Location**

Stesha Pasachnik, Chuck Knapp, Tandora Grant

Puerto Rico and Cuba are being considered for the 2017 ISG Meeting. Our Cuban colleagues are updating the cost details for hosting a meeting. With relaxation of travel restrictions from the USA, and expected development pressures in the country, this may be an opportune time to hold the meeting in Cuba. The Steering Committee will be discussing pros and cons of holding the meeting in both those countries. Since Green Iguanas are not yet documented in Cuba, perhaps this is another great reason to hold the meeting there, as an opportunity to emphasize to in-country partners the importance of preventing introductions.

### **Travel Awardees Update**

Stesha Pasachnik

IIF donations expand this ISG Travel Award fund, and contributions are appreciated and always welcome. Seven travel grants were awarded this year, but Daniel Ariano-Sánchez and Jenn Moss were unfortunately not able to attend. We welcome awardees Adam Clause, Daisy Maryon, Thijs van den Burg, Araceli Samaniego, and Flavia Diotellevi.