



IUCN SSC IGUANA SPECIALIST GROUP ANNUAL MEETING

NOVEMBER 3–5, 2021

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3 November 2021

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|-----------------|--|
| 12:00 pm | Welcome and explanation of virtual meeting format
ISG Co-Chairs: Chuck Knapp and Stesha Pasachnik |
| 12:20 pm | Introduction to the Global Center for Species Survival
Nikki Roach* |
| 12:40 pm | Introduction to the Green Status of Species Assessment Tool and ISG Update
Tandora Grant*, Stesha Pasachnik |
| 1:00 pm | Conservation of the Jamaican Rock Iguana, <i>Cyclura collei</i>
Stesha Pasachnik*, David Reid |
| 1:20 pm | Anegada Rock Iguana 2020–21 Program Update
Kelly Bradley* |
| 1:40 pm | <i>BREAK</i> |
| 1:50 pm | Update on Aspects of the Population Status of the Mona Rhinoceros Iguana, <i>Cyclura stejnegeri</i>
Nestor Perez-Buitrago*, Carlos Diez, Alberto Sabat |
| 2:10 pm | Planning for the Future: Preserving Conservation Achievements for the Grand Cayman Blue Iguana (<i>Cyclura lewisi</i>)
Luke Harding*, Annette Gunn, Frederic J. Burton |

All times are Noon–5:00 PM CDT (GMT -5)

- 2:30 pm** **Veterinary Support as an Essential Component of Iguana Conservation Programs: Grand Cayman Blue Iguana (*Cyclura lewisi*) Conservation Experience and Outcomes from a Long-term Veterinary Program**
Paul P. Calle*, Kenneth J. Conley*, Luke Harding, Frederic J. Burton (*joint presentation)
- 2:50 pm** **Raising Awareness of Endangered Species Through the Use of Digitally Created Characters**
Justin Weeks*
- 3:10 pm** **Lockdown and Cyclone Effects on Fiji Iguana Conservation**
Robert Fisher*, Steve Anstey, Kim Gray, Isz Nacewa, Eroni Matatia, Jone Niukula
- 3:30 pm** **Results of a Feasibility Study for the Reintroduction of the Fijian Crested Iguana (*Brachylophus vitiensis*) to Castaway Island, Fiji**
Peter Harlow*, Marica Vakacola, Alifereti Naikatini

Join us in REMO for an open discussion among attendees directly after the session

4 November 2021

- 12:00 pm** **Welcome and explanation of virtual meeting format**
ISG Co-Chairs: Chuck Knapp and Stesha Pasachnik
- 12:15 pm** **Remote Tracking of Galápagos Pink Land Iguana Reveals Large Elevational Shifts in Habitat Use**
Marco Gargano*, Giuliano Colosimo, Pierpaolo Loreti, Lorenzo Bracciale, Massimiliano De Luca, Corrado Di Natale, Carlos Vera, Christian R. Sevilla, Glenn P. Gerber, Gabriele Gentile
- 12:35 pm** **Population Size Estimates and Range Distribution Modeling of *Conolophus marthae* using Long-term Mark-recapture and Remote Sensing Data**
Giuliano Colosimo*, Marco Gargano, Greg Lewbart, Pierpaolo Loreti, Lorenzo Bracciale, Massimiliano De Luca, Glenn Gerber, Gabriele Gentile
- 12:55 pm** **Gross and Microscopic Skin Structure of Three Galápagos Iguana Species**
Gregory Lewbart*, Tatiane Terumi Negrao Watanabe*, Christopher Gaudette, Giuliano Colosimo, Glenn Gerber, Joshua Parker, Gabriele Gentile
- 1:15 pm** **A Genomic Perspective on the Demographic History of Galápagos Iguanas**
Julia López-Delgado*, Cecilia Paradiso*, Paolo Gratton, Emiliano Trucchi, Ian M. Carr, Mohd Firdaus Raih, Mohd Noor Mat Isa, Syafiq Rahim, Simon J. Goodman, Gabriele Gentile (*joint presentation)

All times are Noon–5:00 PM CDT (GMT -5)

- 1:40 pm** **Galapagos Pink Land Iguana (*Conolophus marthae*): Conservation and Management Plan 2021–2026**
 Danny Rueda, Paula A. Castaño*, Wilson Cabrera, Karl J. Campbell, Victor Carrión, Jorge Carrión, Giuliano Colosimo, Joe Flanagan, Gabriele Gentile, Glenn Gerber, *et al.*
- 2:00 pm** ***BREAK***
- 2:10 pm** **Conservation of *Ctenosaura oedirhina***
 Kwanho Ki*, Stesha Pasachnik, Susannah French, Ashley Goode
- 2:30 pm** **COVID-19 Impacts on Iguana Conservation at Heloderma Natural Reserve, Guatemala**
 Johana Gil-Escobedo*, Daniel Ariano-Sánchez
- 2:50 pm** **Tourism-induced Effects on the Gut Microbiome of Bahamian Rock Iguanas**
 Erin Lewis*, Karen Kapheim, Alison Webb, Charles Knapp, John Iverson, Frank Oliaro, Dale DeNardo, Susannah French
- 3:10 pm** **Anthropause: Responses to the COVID-induced Cessation of Tourism in Northern Bahamian Rock Iguanas**
 Charles Knapp*, Susannah French* (*joint presentation)
- 3:30 pm** **Discussion — Future Access and Benefits Sharing with Range Countries**
 Chuck Knapp, moderator

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5 November 2021

- 12:00 pm** **Welcome and explanation of virtual meeting format**
 ISG Co-Chairs: Chuck Knapp and Stesha Pasachnik
- 12:15 pm** ***Ctenosaura similis* and *Iguana iguana* Retreat Sharing in Suburban Florida**
 Ann-Elizabeth Nash*, Jill Jollay* (*joint presentation)
- 12:35 pm** **Strengthening Biosecurity to help Turks and Caicos Island's Iguana Islands**
 Simon Busuttil*
- 12:55 pm** **Impact of the Invasive Common Green Iguana (*Iguana iguana*) on 20 Farms in Puerto Rico**
 Christina De Jesús Villanueva*, Gabriela Massanet Prado, William Gould, Jason Kolbe
- 1:15 pm** ***BREAK***
- 1:25 pm** **The Martinique Iguana Early Detection Network: Hopes and Challenges**
 Nathalie Duporge*, Emy Njoh-Ellong, Kévin Urvoy, Nicolas Paranthoën

All times are Noon–5:00 PM CDT (GMT -5)

- 1:45 pm** **Small-scale Mapping as a Tool to Identify High Priority Areas for the Conservation of *Iguana delicatissima***
Baptiste Angin*, Chloé Warret Rodrigues Junior, Fortuné Guiougou
- 2:05 pm** **Hurricane-induced Population Decrease in a Critically Endangered Long-lived Reptile**
Hannah Madden*, Matthijs van den Burg, Tim van Wagensveld, Erik Boman
- 2:25 pm** **Iguana Conservation Actions in Dominica**
Jeanelle Brisbane*
- 2:45 pm** **Panel Discussion — Inclusion and Gender in Conservation**
Opening Panelists: Stesha Pasachnik, Chuck Knapp, Tandora Grant, Allison Alberts, Jeanelle Brisbane, Johana Gil-Escobedo, Ana Daniela Sansur Pavon, Eugenia Zarza

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ORAL PRESENTATION ABSTRACTS

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

Small-scale Mapping as a Tool to Identify High Priority Areas for the Conservation of *Iguana delicatissima*

Angin, Baptiste^{*1}, Chloé Warret Rodrigues Junior², and Fortuné Guiougou³

¹Ardops Environnement, Les Abymes, Guadeloupe, French West Indies; ²University of Manitoba, Winnipeg, Canada; ³Association Le Gaïac, Sainte Rose, Guadeloupe, FWI

Iguana delicatissima, an endemic species from Lesser Antilles, has been reassessed in 2018 and is now categorized as Critically Endangered by the IUCN Red List of Threatened Species. The main threat to its persistence is the competition and hybridization with *Iguana iguana*. Among other threats to the survival of *Iguana delicatissima*, habitat destruction and alteration is of particular importance, but is unfortunately rarely prioritized in conservation programs. Here we present a study based on a small island, La Desirade (22 km²), off the coast of Guadeloupe, that shelters one of a last pure populations of *Iguana delicatissima*. We evaluated the threats to the habitat using natural and anthropogenic variables, and ecology data on the species (nesting area, observations, etc.) for each one-square-kilometer cell of a grid overlayed on the island. Each variable was given a positive score based on the risk it posed to the species or a negative score if it provided additional protection. We then aggregated these scores into an overall result and classified each cell into one of four conservation-priority levels, thus highlighting the most vulnerable areas for the conservation of the species' habitat. This work can be used as a tool by the managers and the municipality to select the areas where it is most urgent to act and integrate the protection of this valuable species in development operations.

Anegada Rock Iguana 2020–2021 Program Update

Bradley, Kelly*

Fort Worth Zoo, Fort Worth, Texas, USA

The Anegada Rock Iguana headstart program is heading into its 25th year. Because of our partnership with the National Parks Trust of the Virgin Islands (NPTVI), 272 headstarted iguanas have been released back to the wild. The COVID-19 pandemic and the resulting lock-downs have dealt another devastating blow to the recovery program and the NPTVI. In partnership with the Royal Botanical Gardens KEW, a COVID-19 Rapid Response Grant was obtained through the Darwin Initiative to help the NPTVI continue operations and document the impacts and consequences of the pandemic on conservation in the BVI. We will highlight the limited activities that have taken place over the last year, discuss the effects of the pandemic on the program, and the major outcomes from the COVID-19 Rapid Response Grant.

Iguana Conservation Actions in Dominica

Brisbane, Jeanelle*

WildDominique, Roseau, Dominica

Prior to Hurricane Maria in 2017, Dominica stood as the last stronghold for the Lesser Antillean Iguana (*Iguana delicatissima*). However, in 2018, less than one year after the passage of the strongest storm in Dominica's recorded history, the invasion of the Common Green Iguana (*Iguana iguana*) threatened the species' survival. This presentation journeys through the conservation effort to protect this Critically Endangered iguana while navigating the unspoken waves of local capacity, politics, and colonial science.

Strengthening Biosecurity to Help Turks and Caicos Island's Iguana Islands

Busuttil, Simon*

Royal Society for the Protection of Birds, Turks and Caicos Islands

Following years of targeted conservation work, the Turks and Caicos Rock Iguana (*Cyclura carinata*) has been down-listed from Critically Endangered to Endangered in 2020. The UK Government through its Darwin fund, is financing a project to strengthen biosecurity across the Turks and Caicos Islands, primarily targeted at *Cyclura carinata*. This presentation gives an update at roughly one-third of the way through the project.

Veterinary Support as an Essential Component of Iguana Conservation Programs: Grand Cayman Blue Iguana (*Cyclura lewisi*) Conservation Experiences and Outcomes from a Long-Term Veterinary Health Program

Calle, Paul P.*¹, Kenneth J. Conley*¹, Luke Harding², and Frederic J. Burton³ (*joint presentation)

¹Wildlife Conservation Society, Bronx, New York, USA; ²Blue Iguana Conservation Programme, National Trust for the Cayman Islands, Cayman Islands; ³Department of Environment, Grand Cayman, Cayman Islands

Veterinary medicine is an essential element of conservation programs, including iguana conservation, especially those with a captive component and those with field components including biological sampling and monitoring to identify illnesses and deaths in wild populations. The Wildlife Conservation Society (WCS) has provided veterinary support for Blue Iguana Conservation (BIC) [formerly Blue Iguana Recovery Program (BIRP)] on Grand Cayman since 2001. There are multiple aspects of this collaboration which have directly contributed to the positive conservation results of the program, and others which have deepened the understanding of the species to improve *in situ* and *ex situ* captive management. Clinical efforts have included annual health assessments of captive and wild Grand Cayman Blue Iguanas (*Cyclura lewisi*), pre-release health evaluations, determination of parasite levels, presence of enteric *Salmonella*, normal blood values and the effect of handling times on these parameters, and comparisons of these values between captive and wild iguanas. WCS has also provided pathology support to BIC by one dedicated pathologist for the past eight years. In addition to determination of specific diseases and mortality events, routine pathology examinations can also provide conservation programs with information regarding underlying health conditions that can affect the broader population and may otherwise go unrecognized until clinically significant disease occurs. Pathology investigations identified a novel *Helicobacter* that was responsible for morbidity and mortality in captive and wild iguanas. This presentation will provide an overview of the veterinary health component of BIC, a summary of veterinary-related research findings produced, and the role pathology plays in conservation.

Population Size Estimates and Range Distribution Modeling of *Conolophus marthae* using Long-term Mark-Recapture and Remote Sensing Data

Colosimo, Giuliano*¹, Marco Gargano², Gregory Lewbart³, Pierpaolo Loreti², Lorenzo Bracciale², Massimiliano De Luca⁴, Glenn Gerber¹, and Gabriele Gentile²

¹San Diego Zoo Wildlife Alliance, Escondido, California, USA; ²Università Roma Tor Vergata, Roma, Italia; ³North Carolina State College of Veterinary Medicine, Raleigh, North Carolina, USA; ⁴Italian National Council of Research, Roma, Italia

We used long-term mark-recapture data to estimate population size and distribution range for Critically Endangered Galápagos Pink Land Iguanas, *Conolophus marthae*. This species is endemic to the Galápagos archipelago and can only be found on the north-western slopes of Wolf Volcano on Isabela Island. Field work data have suggested that the species is restricted to a narrow area measuring *ca* 25 km² and that the adult population size is small, not exceeding

300 individuals. We have organized the information collected in the field since 2006, and enhanced it with the georeferenced data collected remotely using custom-developed GPS satellite tags attached to adult individuals in 2019 and 2021. These data were used within different statistical frameworks to more accurately estimate population size and to better define the species distribution range. We further used the collected data to describe the movement ecology of individuals within their range. We hypothesized that males and females may use the habitat differentially based on, for example, the reproductive season. Our results indicate an estimated adult population size of *ca* 300 individuals, in-line with previous evaluations. Estimates of distribution range, on the contrary, revealed that the territory where these iguanas persist is smaller than previously thought and no larger than 16 km², confirming the ultra-endemic nature of this species, and the importance of this area for the species survival. While looking at individuals' usage of the range, we were able to identify a specific region that is preferentially used by females during the reproductive season. This site represents a potential nesting ground for adult female Pink Land Iguanas and it should be investigated in future expeditions. Once nests are located, hatchlings could be collected to initiate a headstart program, one of the high priority conservation strategies identified in the recently developed action plan.

Impact of the Invasive Common Green Iguana (*Iguana iguana*) on 20 Farms in Puerto Rico

De Jesús Villanueva, Christina^{*1,2}, Gabriela Massanet Prado³, William Gould², and Jason Kolbe¹

¹University of Rhode Island, Kingston, Rhode Island, USA; ²USFS International Institute of Tropical Forestry, San Juan, Puerto Rico; ³University of Puerto Rico, San Juan, Puerto Rico

The Common Green Iguana (*Iguana iguana*) is considered a widespread invasive species in multiple islands and territories in the South Pacific, Southeastern Asia, and the Caribbean. Where introduced, this invasive species poses a threat to endemic iguana species through hybridization and competition. Concerns over this herbivorous lizard's impact on agricultural production have also been cited, though little work has been done to explore the Common Green Iguana's relationship with people. In this study, we begin to explore the impact of the invasive Common Green Iguana on agricultural communities, by conducting 20 semi-structured interviews with farmers in Puerto Rico. Our findings reveal over 40 species of crops that are impacted by invasive Common Green Iguanas, provide initial estimates of the economic cost of this species to crop production, and give insight into the mitigation strategies available to prevent crop loss.

The Martinique Iguana Early Detection Network: Hopes and Challenges

Duporge, Nathalie*¹, Emy Njoh-Ellong², Kévin Urvoy², and Nicolas Paranthoën³

¹Nathalie Duporge Wildlife Consultant, Le Carbet, Martinique, French West Indies; ²Office National des Forêts, Fort-de-France, Martinique, French West Indies; ³Office National des Forêts, Basse-terre, Guadeloupe, French West Indies

At the southern end of the range of the Lesser Antillean Iguana (*Iguana delicatissima*), Martinique is home to residual populations that are critical to its conservation. As on too many other islands, mainland Martinique is suffering from the proliferation of the Common Green Iguana (*Iguana iguana*). More prolific and competitive, the invasive has been identified by the Plan National d'Actions (NAP) as the main threat to the survival of *Iguana delicatissima* because of its ability to colonize and hybridize within contact areas of the two species. This has led to the disappearance of *Iguana delicatissima* from Saint Martin/Sint Marteen, Les Saintes, Grande Terre, and others.

Aware of the major stakes of trying to prevent the two species from hybridizing, the NAP has set up *Iguana iguana* regulation as a priority action. Among the identified tools for these actions, creating a Martinique Iguana Early Detection Network (MIEDN) was decided in 2018 for the Atlantic and North territories of Martinique, that still contain *Iguana delicatissima* populations. The objectives of MIEDN was to establish a network of volunteers and structures active in the management of the Common Green Iguanas. The proper functioning of such a network relies on good public information on the issues to encourage reports of sightings, training and equipping network members on identifying the two species, and then capturing and managing the reports.

Launched in 2019, and now benefiting from three years of operation, here is a first assessment of the functioning and actions of the MIEDN, a highlight of the strengths and weaknesses of this tool, and an identification of the future challenges to be met to achieve the objective of protecting *Iguana delicatissima* from hybridization with *Iguana iguana*, and effectively fight against the proliferation of the Common Green Iguana.

Lockdown and Cyclone Effects on Fiji Iguana Conservation

Fisher, Robert*¹, Steve Anstey², Kim Gray³, Isz Nacewa⁴, Eroni Matatia⁵, and Jone Niukula⁵

¹U.S. Geological Survey, San Diego, California, USA; ²Ahura Resorts Conservation Foundation, Nadi, Fiji; ³San Diego Zoo Wildlife Alliance, San Diego, California, USA; ⁴Likuliku Lagoon Resort, Malolo Levu, Fiji; ⁵National Trust of Fiji, Suva, Fiji

The Fiji iguana program has faced several challenges over the last year. First, we review the impact of the shutdown on our public-private partnership on Malolo Island with Ahura Resorts. On March 2020, both resorts closed and skeleton staff were maintained to look after resort assets. Basic maintenance of the iguana captive populations and the dry forest nursery work continued. Introduction of Delta COVID strain led to a major national lockdown from April 2021 to present. With limited staff resources at the resorts, the risks of predatory mammal re-invasion

and wildfires was great. These issues presented in late 2021, creating unmitigated problems, especially the wildfire that almost destroyed the dry forest restoration site. No one could be dispatched to fight the fire due to lockdown. New cages funded for the captive colony have been on hold since building materials cannot get to the island. Second, we review the devastating impacts of the December 2020 Category 5 and January 2021 Category 3 cyclones on Yadua and Yadua Taba. The National Trust of Fiji (NTF) Ranger Office was destroyed, as was the Ranger's house. NTF's new four-stroke engine was destroyed, but luckily the new Ranger boat was not lost. The planning for translocation of Fijian Crested Iguanas from Yadua to Yadua Taba was stalled. The IIF-funded invasive plant assessment of the Yadua peninsula was delayed, as is the planning for the goat and cat exclusion fencing. Both the Monuriki and Yagaqa study sites suffered cyclone damage. We have not been able to evaluate the damage or forest regeneration work on Monuriki. With the near-term, projected re-opening of travel within Fiji, assessments can be completed for the current status of iguanas and their habitats at these conservation sites.

Remote Tracking of Galápagos Pink Land Iguana Reveals Large Elevational Shifts in Habitat Use

Gargano, Marco*¹, Giuliano Colosimo², Pierpaolo Loreti¹, Lorenzo Bracciale¹, Massimiliano De Luca³, Corrado Di Natale¹, Carlos Vera⁴, Christian R. Sevilla⁴, Glenn Gerber², and Gabriele Gentile¹

¹Università Roma Tor Vergata, Roma, Italia; ²San Diego Zoo Wildlife Alliance, Escondido, California, USA; ³Italian National Council of Research, Roma, Italia; ⁴Galápagos National Park Directorate, Puerto Ayora, Galápagos, Ecuador

The Critically Endangered Galápagos Pink Land Iguana, *Conolophus marthae*, can be considered a rare and elusive species. This iguana is endemic to Wolf Volcano, on Isabela Island (Galápagos), where it persists as a single, very small population on the northwestern slope of the volcano. In the attempt to unveil important information about this species' ecology and behavior, we monitored and analyzed the movement data of a male *C. marthae* collected from 25 September 2019 to 3 March 2020. We used a custom-designed GPS Wireless Sensor Node to remotely track and describe the migrating pattern of this individual. Thanks to GPS location data and trajectory reconstruction, we were able to document an altitudinal shift of more than 1,000 meters. This data not only agrees with personal observations recorded while collecting data in the field, but was also used to reconstruct and describe the individual's behavior, and to document the potential path that this individual, and presumably others of this species, follow while searching for food or mates. The altitudinal shift described here, whether shared across individuals of the species or part of the intraspecific variation, may be related to different factors and could be interpreted as a strategy that would allow Pink Land Iguana individuals to obtain alternative trophic resources, in response to variation in seasonal food availability. Although it is not possible to draw conclusions for an entire species based on results from one individual, the urgent need to gather data on this species' ecology underlines the importance of this research. This work represents a great advancement for the conservation of this species as it validates the importance of using remote-tracking technology to collect data on a very elusive species, and it helps to uncover ecological traits never before documented for this Critically Endangered iguana.

COVID-19 Impacts on Iguana Conservation at Heloderma Natural Reserve, Guatemala

Gil-Escobedo, Johana* and Daniel Ariano-Sánchez

Heloderma Natural Reserve, El Arenal, Guatemala

The Heloderma Natural Reserve (HNR) and its neighboring lands harbor one of the last remnants of dry forest in Guatemala and protects one of the largest remnant populations of the Motagua Spiny-tailed Iguana (*Ctenosaura palearis*). The COVID-19 pandemic, along with climate change effects in the last couple of years have had huge impacts on the iguana conservation programs carried out at the HNR. The HNR remained closed for almost a year in 2020 due to COVID-19 government restrictions of movement. The HNR subsists by income from private donors, visitors, and a government agency through a forestry conservation financial incentive. Unfortunately, the economic crisis created by the COVID-19 pandemic had huge impacts on the HNR's financial health. Visitors declined from an average of 50 visitors per month to zero for a period of nine months (March to December 2020). Government restrictions also stopped face-to-face education at schools during 2020, directly affecting our iguana conservation education program. Also, the economic crisis made the government redistribute funds to address the pandemic, cutting the forestry conservation incentive given to the HNR by 20%. These funds are crucial to cover salaries for two forest guards at the HNR. Additionally, in November 2020, an unprecedented event of two Category 5 hurricanes (Eta and Iota), hit the country in a period of less than two weeks apart. The hurricanes hit the HNR with huge strength, causing extensive damage to the infrastructure. These synergistic impacts compromised the iguana conservation and education programs held at the HNR. Fortunately, the IIF Emergency Fund, along with donations from other private sources and fellows of the HNR, have saved the financial situation of the HNR to keep operations moving. Thanks to this help, we were able to maintain control of operations at the HNR and resume iguana conservation programs in 2021.

Introduction to the Green Status of Species Assessment Tool

Grant, Tandora*¹ and Stesha Pasachnik²

¹San Diego Zoo Wildlife Alliance, San Diego, California, USA; ²Fort Worth Zoo, Texas, USA

First conceptualized at the IUCN World Congress in 2012, the Green Status of Species has been created as an adjunct tool to the IUCN Red List of Threatened Species. Over the last three years, 204 co-authors tested this newly developed Green Status framework prior to the standards being finalized, using data from 181 species across the tree of life. An example assessment will be shared — analysis from the Critically Endangered Jamaican Rock Iguana which was thought to have gone extinct in the mid-1940s and has been the subject of intense conservation efforts since its rediscovery in 1990.

The IUCN Green Status of Species represents the first standardized method to quantify a species' conservation efforts (or lack thereof) and its potential for recovery. This new assessment measures the impact of past conservation, a species' dependence on continuing

support, how much a species stands to gain from continued conservation action within the next ten years, and the potential for it to recover over the next 100 years. Within this context, recovery is defined as a measure of how close a species is to being viable (no longer in a threatened Red List category) and fully ecologically functional across its pre-human impact range. These assessments can provide evidence that conservation has been working despite a Red List status that has remained in a threatened category for many years, for example. It may engender optimism and inspire further conservation efforts.

Planning for the Future: Preserving Conservation Achievements for the Grand Cayman Blue Iguana (*Cyclura lewisi*)

Harding, Luke*¹, Annette Gunn¹, and Frederic J. Burton²

¹Blue Iguana Conservation Programme, National Trust for the Cayman Islands, Cayman Islands;

²Department of Environment, Grand Cayman, Cayman Islands

Although rightly hailed as a conservation success story, the emergence of new data and an increased understanding of threats to the Grand Cayman Blue Iguana (*Cyclura lewisi*) indicate that the restored population is unlikely to be able to sustain itself in the long-term and that this species is risking a trajectory back towards Critically Endangered status on the IUCN Red List of Threatened Species unless ambitious measures are taken immediately.

A new five-year Strategic Species Action Plan, supported by the Darwin Initiative, highlights the importance and need to mitigate the ongoing threats, particularly from invasive species, in order to establish and maintain a genetically and demographically resilient population. The plan outlines the key strategies required to achieve the vision, which include maintaining and strengthening the protected areas, filling essential data gaps, and accumulating funding for Blue Iguana Conservation. Priority objectives of the plan are to protect the *C. lewisi* population within the Queen Elizabeth II Botanic Park to become Cayman's first 'Habitat Island' and to increase future on-island support by ensuring that Cayman's community is once again at the heart of conservation efforts, which is crucial to safeguard the vital support and celebration of this flagship species into the future.

Results of a Feasibility Study for the Reintroduction of the Fijian Crested Iguana (*Brachylophus vitiensis*) to Castaway Island, Fiji

Harlow, Peter*¹, Marica Vakacola², and Alifereti Naikatini³

¹Taronga Conservation Society Australia, New South Wales, Australia; ²Mamanuca Environment Society, Nadi, Fiji; ³South Pacific Regional Herbarium, University of the South Pacific, Suva, Fiji

Castaway Island, Fiji (Qalito Island in Fijian), is one of three islands prioritized for reintroduction of Fijian Crested Iguanas in the IUCN SSC Fijian Crested Iguana Species Recovery Plan 2008–2012. Despite having extensive native forest, no iguanas have been recorded on Castaway Island in living memory. We investigated the potential to successfully reintroduce Crested

Iguanas by addressing their known requirements: absence of exotic predators (cats, mongoose, Black and Norway Rats) and forest fires, and the abundance of important plant species in their diet. Today, Castaway Island (57 ha) meets all of these criteria.

After feral cats were eradicated from Castaway in 2020, we surveyed 36 ha (63% of Castaway) of closed tropical dry forest. Gentry transects showed that nine tree species important in the diet of the Crested Iguana make up 23% of all forest trees. This translates into > 34,000 individual trees. In addition, five species of edible shrubs and vines are also common in the forest understory.

For cultural and genetic reasons, only Crested Iguanas from nearby Malolo Island (9.7 km²) should be translocated to Castaway. Malolo Island is only 850 m from Castaway, and the recently rediscovered Crested Iguana on Malolo survives in only three small and isolated populations totaling less than 150 individuals. These Malolo populations are highly vulnerable to continuing habitat loss, regular wildfires, cat predation, and inbreeding depression.

We recommend a novel approach to genetic management of translocated iguanas to ensure that both islands represent a single metapopulation. We envisage translocation of iguanas in BOTH directions: 1) among all three populations on Malolo, and 2) between the three Malolo populations and Castaway, over several decades. This will ensure that the full genetic diversity of the three isolated Malolo populations is maximized, and is fully represented in the new Castaway Island iguana population.

Anthropause: Responses to the COVID-induced Cessation of Tourism in Northern Bahamian Rock Iguanas

Knapp, Charles*¹ and Susannah French*² (*joint presentation)

¹Daniel P. Haerther Center for Conservation and Research, John G. Shedd Aquarium, Chicago, Illinois, USA; ²Utah State University, Logan, Utah, USA

Wildlife feeding by tourists is a widespread phenomenon across various species and environments. While it can provide important economic benefits to countries and local communities, it also poses significant challenges for affected wildlife. These widespread practices may induce habituation, cause stress, impact immunocompetence, and alter growth and survival, all of which can lead to changes at the population level. However, the ability to control for extraneous factors in tourism-related wildlife feeding conditions is often difficult if not impossible, rendering scientific study challenging. Furthermore, the effects of termination of wildlife feeding have rarely been considered. The unprecedented cessation of tourism and food provisioning due to the COVID-19 global pandemic has created a natural experiment that meets the aforementioned challenges to directly test the effects of this phenomenon on rock iguanas in The Bahamas. We tested the effects of the cessation of supplemental feeding on the diet, microbiome, physiology, and demography (and their interactions) of a long-lived rock iguana. This model system is ideal because of the availability of a 40-year continuous life history data set, on both tourist-visited and unvisited islands. Overall, we found that previous physiological distinctions from high-tourist sites were no longer present in most cases, whereby

circulating energy metabolites in animals from high tourist sites now resembled levels in animals with no tourism exposure or feeding. Likewise, previous differences in body condition immunity, oxidative status, and corticosterone in iguanas from fed populations were also mostly absent. Moreover, the majority of significant changes following the pandemic were observed at high tourist sites that are frequented by tour operators. This natural experiment that occurred over the last year due to the COVID-19 pandemic will inform the effects of feeding cessation and potential management directions in the future for these populations.

Conservation of *Ctenosaura oedirhina*

Ki, Kwanho Claudia*¹, Stesha Pasachnik², Susannah French¹, and Ashley Goode³

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The Roatán Spiny-tailed Iguana (*Ctenosaura oedirhina*) is endemic to the Honduran island of Roatán and listed as Endangered by the IUCN Red List of Threatened Species with *ca* 3,760–7,360 iguanas left in the wild. Over the past 11 years, we have tagged and monitored 1,201 iguanas to understand their natural history and habitat use, genetic structure and gene flow between fragmented populations, and more recently, gain an understanding of their reproduction using an eco-physiological approach. Due to the COVID-19 pandemic, we have been unable to return to Roatán since 2019 and the conservation status of the species is currently unknown. In-country collaborators have related that harvesting pressure has spiked due to economic hardship associated with COVID-19-related tourism shutdowns. We can expect this to continue as long as the economic hardship continues. In 2022, we plan to return to Roatán to update population estimates, assess health and environmental threats, and continue to study the iguana's reproductive ecology. We will use a mark-recapture technique to survey the iguana population, while taking a concurrent blood sample and morphometrics. At each site, environmental threats such as human presence, noise disturbance levels, predators (cats and dogs), and habitat modification or destruction will be identified and quantified. With this approach, we will assess health biomarkers using biochemical assays and relate them to relevant environmental threats. Finally, radiotelemetry and camera traps will identify nest locations. This will also give us a better idea of the timeframe when reproductive females are most vulnerable to disturbances and whether there are differences in reproductive phenology across study sites. By obtaining population estimates, health status, assessing threats, and better understanding reproduction, we will elucidate immediate threats to the population. Our proposed actions will be critical to ensuring the conservation of *C. oedirhina* by gathering important information necessary for management decisions.

Gross and Microscopic Skin Structure of Three Galápagos Iguana Species

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The Galápagos archipelago is home to four species of iguanas: the Marine Iguana (*Amblyrhynchus cristatus*), the Galápagos Land Iguana (*Conolophus subcristatus*), the Barrington Land Iguana (*Conolophus pallidus*), and the Pink Land Iguana (*Conolophus marthae*). To our knowledge, no studies have been published on the microscopic anatomy of the skin of Galápagos iguanas. The Pink Land Iguana was only described in 2009 and is a relative newcomer to study by ecologists and zoologists. While there were a number of hypothesis on the source of their pink color, including that the color was from blood and a relative lack of dermal pigmentation. We obtained full thickness skin biopsies from three species (the Barrington Land Iguana was excluded) and compared tissue from darkly pigmented surfaces and lightly pigmented surfaces. The results were striking. The “pink” area of the Pink Land Iguana is devoid of melanin (melanophores) and the dermal tissue is rich with confluent vascular channels. This was in sharp contrast to the minimally vascular (only capillaries were observed and in some cases were rare) dermal areas of the Marine Iguana and Galápagos Land Iguana (yellow iguanas). The dermal stratum laxum of every biopsy site contained melanophores except for the pink skin of the Pink Land Iguana. Interestingly, the Marine Iguana has a much thicker epidermis, between three and 10 cells thick depending on location, compared to the thinner epidermis of the land iguanas (one to four cells thick with most areas possessing just one or two cell layers). These microscopic differences might reflect the diversity of habitats and habits of the three species. However, the adaptive significance of such a trait for the Pink Land Iguana is ground for further investigation.

Tourism-induced Effects on the Gut Microbiome of Bahamian Rock Iguanas

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In recent years feeding wildlife has become a popular part of the tourist experience. This practice has been particularly prevalent and consistent in several populations of Bahamian Rock Iguana in the Exumas, The Bahamas. The implications of feeding on animal health include potential changes to the microbiome due to the impacts of diet on gut microbiota. Gut microbial composition has been known to play a key role in physiological and immunological processes, which could have many potential impacts for the affected populations and overall species' health. Results thus far have found significant differences in microbiome composition between sexes and between populations with varying levels of tourist activity. These microbial changes and resulting physiological effects could lead to longer-term health issues and impact overall population health.

A Genomic Perspective on the Demographic History of Galápagos Iguanas

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Genomes retain information on the demographic changes and evolutionary forces shaping the origin and demographic trajectories of species. The Galápagos iguanas comprise an adaptive radiation that diversified into four species within the archipelago from a Central American ancestor, which likely rafted from the continent. As part of the Iguana Genome Consortium, we aim to shed light on the evolutionary history and adaptations of this endangered taxon. Here, we report de novo genome assemblies for the Galápagos iguanas. The high-quality genome assemblies were generated using Illumina and Oxford Nanopore sequencing data with the MaSuRCA assembly pipeline, and represent the first whole-genome data for these species. We also assembled the RNA-seq blood transcriptome of the Marine Iguana. We performed whole-genome demographic reconstructions for each species using a PSMC approach, which recovers changes in effective population sizes in the distant past. In addition, we obtained a panel of single nucleotide polymorphisms (SNPs) by aligning RAD sequencing data for *Conolophus marthae* and the syntopic population of *C. subcristatus* from Wolf Volcano, which allowed the computation of the site frequency spectra (SFS). The SFS data was analysed using Stairway Plot 2, a demographic reconstruction algorithm suitable to infer recent past changes in effective population size (N_e). Both the PSMC and Stairway Plot 2 reconstructions uncovered fluctuations in N_e , which may be correlated with interspecific competition, sea level changes and climate variation associated with Pleistocene glacial cycles. These demographic inferences enable the study of climatic and geological impacts on natural species and deciphering population trends, which are key to unravel the evolutionary history of species and to design conservation plans for Galápagos iguanas.

Hurricane-induced Population Decrease in a Critically Endangered Long-lived Reptile

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Catastrophic events, like hurricanes, bring lethal conditions that can have population-altering effects. The threatened Caribbean dry forest occurs in a region known for its high-intensity hurricane seasons and high species endemism, highlighting the necessity to better understand hurricane impacts as fragmentation and clearing of natural habitat continues. However, such studies remain rare, and for

reptiles are mostly restricted to *Anolis*. Here we used single-season occupancy modeling to infer the impact of the intense 2017 Atlantic hurricane season on the Critically Endangered Lesser Antillean Iguana, *Iguana delicatissima*. We surveyed 30 transects across eight habitats on St. Eustatius during 2017–2019, which resulted in 344 individual surveys and 98 iguana observations. Analyses of abundance and site occupancy indicated both measures for 2018 and 2019 were strongly reduced compared to the pre-hurricane 2017 state. Iguanas at higher elevations were affected more profoundly, likely due to higher wind speeds, tree damage, and extensive defoliation. Overall, our results indicate a decrease in abundance (22–23.8%) for 2018 and 2019, and a 75% reduction in the number of opportunistic sightings of tagged iguanas between 2017–2018. As only small and isolated *I. delicatissima* populations remain, our study further demonstrates their vulnerability to stochastic events. Considering the frequency and intensity of hurricanes are projected to increase, our results stress the urgent need for population-increasing conservation actions in order to secure the long-term survival of *I. delicatissima* throughout its range.

***Ctenosaura similis* and *Iguana iguana* Retreat Sharing in Suburban Florida**

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The Common Spiny-tailed Iguana (*Ctenosaura similis*) and the Common Green Iguana (*Iguana iguana*) are invasive species in the state of Florida, with overlapping home and use ranges. Gaps exist in our understanding of their interactions, including shared anti-predator vigilance, foraging competition, and overall social behavior. While congeneric species in México (from the Isthmus of Tehuantepec and south) and throughout Central America, spatial and behavioral ecology suggests *C. similis* and *I. iguana* do not form overlapping dense aggregations in their native range. At our study site in suburban Florida, spiny-tailed and green iguanas were observed living in close proximity (<1 m) to each other with more than 30 individuals of each species. *I. iguana* shared retreats with mature *C. similis* of both sexes and a wide age range. When disturbed, both species would quickly withdraw into retreats, with no apparent congeneric aggression during escape or use. In Costa Rica, female *C. similis* and *I. iguana* nest communally, suggesting shared retreats may be tolerated by adults when necessitated by density of local populations and resource availability. Determining the relationship between these congeneric species may be crucial to improving control efforts where they are invasive.

Conservation of the Jamaican Rock Iguana, *Cyclura collei*

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The endemic Jamaican Rock Iguana (*Cyclura collei*) was considered extinct by the 1940s, due to habitat conversion and invasive alien species (IAS). Its rediscovery in 1990 galvanized the zoo and conservation community to develop an extensive recovery effort focused on headstarting

hatchlings for later wild release, habitat and nest site protection, and IAS control in the iguana's core range. These initial efforts prevented the extinction of the species, but IAS incursions into the core area were still a regular occurrence and the lack of natural recruitment was preventing population growth in the wild. Since 2016, the Jamaican Iguana Recovery Group has worked collaboratively to improve all aspects of this program. The headstart facility at the Hope Zoo in Kingston has been expanded and improved; this year reaching the goal of bringing 50% of the annual hatchlings into the facility. The turnover rate within the headstart facility has also improved and more than 500 individuals have been released back into the wild. Intensive research efforts within the Hellshire Hills have occurred over the past four years and a buffer zone with varied trap and bait types has now been installed that greatly increases the protected area. This will ensure a level of protection needed for natural recruitment and population growth. Novel nest sites have also been identified and protected, and hatchlings from these sites have been incorporated into the headstart program to ensure optimum genetic diversity of the wild population. Outreach and education activities are on-going as permitted with consideration for COVID-19. Together these actions have greatly enhanced the program and opened the door for continued improvement.

Update on Aspects of the Population Status of the Mona Rhinoceros Iguana, *Cyclura stejnegeri*

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The Mona Rhinoceros Iguana *Cyclura stejnegeri* is designated as Endangered by the IUCN Red List of Threatened Species due to low population densities, skewed population structure to adult individuals, and low survival of juveniles. From 1998 to 2006 several aspects of its population ecology were studied, such as nesting ecology and social behavior on Mona Island. In addition, a headstarting program was implemented from 1999 to 2016. During that period, over 500 hatchlings were PIT-tagged. However, no systematic surveys were conducted to determine status of these tagged iguanas for the past 15 years. From August to November 2021, we initiated a capture and recapture study to assess the status of the headstart and wild iguanas, including their growth and survival. So far, we have captured 90 iguanas (50% recaptures) that have survived up to 18 years since they were originally PIT-tagged as adults, mid-sized individuals, or in a few cases as hatchlings. This information is providing data on growth rates, survival, life span, and philopatry. In addition, hatchling success of iguana nests at the coastal nesting sites will be collected for the 2021 season. This data will be compared with the 2006 nesting season. The information collected during this study will allow a timely update on the Mona Rhinoceros Iguana status, including important aspects of the population ecology, currently unknown for this species in the wild.

Introduction to the Global Center for Species Survival

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In 2019, a partnership was developed between the International Union for Conservation of Nature Species Survival Commission and the Indianapolis Zoo to create the first Global Center for Species Conservation (GCSC). This partnership aims to catalyze conservation action across the SSC network. Its main goal is to enhance the scope and capacity for species conservation globally, supporting the efforts of experts working to save threatened species worldwide. The GCSC employs a team of nine experts, including seven taxonomically focused network coordinators, that will liaison with specific specialist groups.

The Galápagos Pink Land Iguana (*Conolophus marthae*): Conservation and Management Plan 2021–2026

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The Galápagos Pink Land Iguana, *Conolophus marthae*, is one of four species of iguanas in the Galápagos Islands, and is listed as Critically Endangered by the IUCN Red List of Threatened Species. The species' distribution is restricted to a small area, of approximately 25 km², with a core area of 10 km², along the northern slopes of Wolf Volcano, Isabela Island. The current estimated population size is approximately 300 individuals, with no record of natural recruitment. Due to its small population, the species is prone to both demographic and genetic stochasticity, as well as environmental impacts (e.g., volcanic eruptions, drought). Invasive species (e.g., feral cats and rats) have been identified as one of the main threats to the natural recruitment and survival of the species. In August 2021, the Galápagos National Park Service convened a group of international and national experts during a three-day workshop to provide advice and work with Park officials to draft a conservation and management plan for the Galápagos Pink Land Iguana. The plan aims to ensure the long-term survival of the Pink Land Iguana, through a comprehensive conservation program that facilitates its recovery and persistence in the wild. During this workshop, it was agreed that work during the first 18

months will focus on two key aspects: 1) identifying and recording the species' specific nesting site locations, and 2) managing invasive species, targeting feral cats and invasive rodents. Following this, we will undertake an assessment of the impact of invasive species management on the natural recruitment of the Pink Land Iguana population and the need to complement these efforts with additional management actions identified by workshop participants, such as headstarting, establishing a second population outside of Wolf Volcano, and captive breeding.

Raising Awareness of Endangered Species Through the Use of Digitally Created Characters

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Animated films have no shortage of memorable characters. They are the subjects of films and are designed intentionally to be appealing. Put simply, audiences love the characters in animated films. That same appeal can be used strategically to aid endangered species. Persons that have a positive attitude towards a particular animal are more likely to want to protect it by assisting in its conservation. This protective instinct can be especially strong in the case of a lovable animated character. If the species is in jeopardy, it is as if the fictional character shares in the danger. To affect the greatest amount of positive change for an endangered species, a film may be made that includes, among its main cast, a character representative of the species, whose character design departs from the actual appearance of the animal for the sake of maximizing appeal. This thesis focuses on the character design and model creation of a stylized Sister Islands Rock Iguana for use in a hypothetical film production.

This particular species was chosen based on its visual appeal and distinct features. The design and where it departs from the form of a real Sister Islands Rock Iguana is derived from the work of Expressionist artists, scientific illustrators, and examples from contemporary animated media. Stylistic modifications to a character's appearance allow for said character to be more appealing than its real-life counterpart. This will increase the audience's attachment to the character, which causes them to be more sympathetic to the plight of the real-life endangered animal. Stylization is already a common practice in the animated film industry, for both human and animal characters alike. Combining Expressionism and scientific illustration will create a stylized model that "feels" cute and is also identifiable as a Sister Islands Rock Iguana.