IUCN SSC Iguana Specialist Group Annual Meeting
Hotel Camino Real, Lake Petén Itza, Guatemala
5–10 November 2023

ORAL PRESENTATION ABSTRACTS

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

Iguana Conservation Efforts in Guatemala: A Decade Later

Ariano-Sánchez, Daniel*[1,2], Johana Gil-Escobedo[2], Gilberto Salazar-Asencio[2], Franklin López[2], and Erick López[2]

[1]Universidad del Valle de Guatemala, Guatemala City; [2]Heloderma Natural Reserve Guatemala, Cabañas, Zacapa, Guatemala

Guatemala is home to six species of iguanas: *Cachyx defensor*, *Ctenosaura acanthura*, *C. flavidorsalis*, *C. palearis*, *C. similis* and *I. iguana rhinolopha*. Conservation efforts carried out by Heloderma Natural Reserve (HNR) at the seasonally dry forests of Motagua Valley have been crucial for preserving this species and promoting local awareness about its importance in the ecosystem. HNR actively preserves the habitat and populations of three of these iguanas: *C. palearis*, *C. similis* and *I. iguana rhinolopha*. Also, last year HNR was involved in the first field research focused on the ecology of *C. defensor* in extreme northern Guatemala resulting in a considerable range extension for the species. This year, HNR has promoted a network of five private and municipally-protected lands called the "Dry Forest Network", focused on the protection of iguana habitat. Education programs carried out for several years have been crucial in promoting the engagement of locals in iguana conservation and developing a group of young people, now called "iguaneros", who are the iguana conservation promoters within Motagua Valley. Habitat restoration efforts, particularly producing and planting dry forest species critical for iguana habitat, along with the establishment of "iguana gardens" built with locals at rural villages within Motagua Valley, are now actively contributing to iguana conservation. Our research efforts have also focused on modeling the impacts of global warming on these species, along with radiotracking and camera trap behavior surveys. Conservation, research, and education achievements are discussed along with the challenges overcome in the last decade of conservation efforts in Guatemala.

Actualización de la Distribución de *Ctenosaura palearis* y Su Depredador, *Heloderma charlesbogerti* con Análisis de los Cambios Potenciales en Respuesta a Diferentes Escenarios de Cambio Climático

Update on the Distribution of *Ctenosaura palearis* and its Predator, *Heloderma charlesbogerti*, with Analysis of Potential Changes in Response to Different Climate Change Scenarios

Birk, Paulina*[1], Daniel Ariano-Sanchez[1], Johana Gil-Escobedo[2], and Diego Incer-Nuñez[1]

[1]Universidad del Valle de Guatemala, Guatemala City; [2]Heloderma Natural Reserve Guatemala, Cabañas, Zacapa, Guatemala

Ctenosaura palearis is a threatened species endemic to the Motagua Valley, Guatemala. One of its main predators is *Heloderma charlesbogerti*, also an endemic and endangered species of the Motagua Valley. This species preys on the iguana's eggs during the nesting season, and both species are closely linked within the ecosystem as the eggs of *C. palearis* constitute one of the main diets of *Heloderma* when it emerges from estivation. This study aims to evaluate the potential current and future distributional effects of climate change on both the iguana and *Heloderma* under different climate change scenarios. Potential distribution models of the species were created for the years 2061–2080, under both an optimistic and a pessimistic scenario, and using current and future climate variables adapted to Guatemala. Potential gains and losses in the distribution of both species were assessed, as well as spatial displacements in their distributions by determining the percentage of overlap within species distributions in both current and future distributions. This will allow assessing the potential impacts of climate change on the predator-prey relationships of both species in the seasonally dry forest of the Motagua Valley and identifying resilient conservation strategies for both threatened species. The models are currently being generated, and final results are expected in the month of October.

Differences Between Semi-Urban and Wild Habitats in Home Ranges, Activity Patterns, and the Potential Impacts of Global Warming on the Metabolic Expenditure of *Ctenosaura palearis*

Castillo-Obregón, Francisco*[1], Johana Gil-Escobedo[2], Gilberto Salazar-Asencio[2], Franklin López[2], and Daniel Ariano-Sanchez[1]

[1]Universidad del Valle de Guatemala, Guatemala City; [2]Heloderma Natural Reserve Guatemala, Cabañas, Zacapa, Guatemala

The Motagua Spiny-tailed Iguana, *Ctenosaura palearis*, is an endangered and endemic species of the semi-arid region of the Motagua Valley. The aim of this study is to determine how habitat quality and ambient temperature affect the movement ecology of *Ctenosaura palearis*. Captured iguanas are equipped with PinPoint GPS Tag system devices, which provide information on their location, the ambient temperature they are exposed to, and their vectorial dynamic body acceleration (VeDBA). These GPS-tagged iguanas are then released, carrying the devices for a period of 15 days. Tags are programmed to take 15 GPS fixes and 132 VeDBA records per day. This study is currently underway and it is expected to provide a more

comprehensive and detailed understanding of the behavioral ecology of *C. palearis*, contributing to conservation decision-making for the species. The study began in April of the current year and is expected to conclude in October. Through June, a total of 12 iguanas (eight females and four males) were monitored. Among these 12 iguanas, eight were monitored in rural areas, while four in urbanized areas. This study will determine how habitat quality and temperature affect the ecology of movement in *C. palearis*. Additionally, comparisons between urban and rural iguanas will be made in terms of their patterns of activity (VeDBA). Furthermore, an assessment of the factors influencing changes in turning angles, step-lengths, and home ranges in *C. palearis* will be conducted.

First Evidence of Recruitment in Critically Endangered Galápagos Pink Land Iguanas (*Conolophus marthae*)

Colosimo, Giuliano*[1], Lorenzo Garizio[1], Marco Gargano[1], Paolo Gratton[1], Glenn Gerber[2], Greg Lewbart[3], Christian Sevilla[4], and Gabriele Gentile[1]

[1]University of Rome Tor Vergata, Rome, Italy; [2]San Diego Zoo Wildlife Alliance, Escondido, California, USA; [3]College of Veterinary Science, North Carolina State University, Raleigh, North Carolina, USA; [4]Galápagos National Park Directorate, Puerto Ayora, Galapagos Islands, Ecuador

We present the first estimate of population dynamic parameters for Critically Endangered Galápagos Pink Land Iguana, *Conolophus marthae*, leveraging mark-recapture data collected between 2006 and 2021. Demographic parameters were estimated using the POPAN formulation of the Jolly-Seber model. This approach provided a solid and robust estimate, consolidating the results obtained from previous estimates based on Lincoln-Petersen method evaluating only two sampling occasions. Our results suggest that males' abundance was higher than females' at each sampling occasion, probably due to differences in sex-related behavior during the reproductive season. Our analyses also provide no evidence of neither an increase nor a decrease in population size, estimated at 150–270 adult individuals, while suggesting positive entry rates. Finally, by comparing the biometric features of first-captured vs. recaptured iguanas we found that the former have more juvenile-like characteristics (i.e., they are smaller on average) than the latter. Although juvenile Pink Land Iguanas have rarely been recorded (only 4 sampled juvenile-like individuals in over 16 years of field work), our combined results provide the first clear indication that the only known *C. marthae* reproductive population actively recruits new members from younger age classes. Such recruitment may have prevented further population decline in the last 16 years, but it was not sufficient to clearly increase the population size. These results are of the utmost importance for the conservation of this species. They will guide future high-priority actions: 1) aiming at increasing population size by removing or mitigating threats, and 2) increasing the number of individuals by implementing a headstart program and/or founding a second viable population, as identified in the recently published IUCN Conservation and Management Plan.

Remote Monitoring of Sister Islands Rock Iguanas on Cayman Brac: A Pilot Project Funded by Darwin Plus Local

Colosimo, Giuliano*[1], Jane Haakonsson[2], Gregory Lewbart[3], Gabriele Gentile[1], Pierpaolo Loreti[1], Massimiliano De Luca[4], Lorenzo Bracciale[1], and Glenn Gerber[5]

[1]University of Rome Tor Vergata, Rome, Italy; [2]Cayman Islands Department of Environment, Grand Cayman, Cayman Islands; [3]College of Veterinary Science, North Carolina State University, Raleigh, North Carolina, USA; [4]CNR, Italian National Council of Research, Rome, Italy; [5]San Diego Zoo Wildlife Alliance, Escondido, California, USA

Sister Islands Rock Iguanas (SIRI, *Cyclura nubila caymanensis*) are endemic to two of the three Cayman Islands: Little Cayman and Cayman Brac. The Little Cayman SIRI population is significantly larger than that of Cayman Brac and has been the focus of intensive study, monitoring efforts, and conservation actions. At 36 km^2 and around 2,000 people, Cayman Brac is a larger island with a larger human population than on Little Cayman (26 km^2, around 200 people). Nonetheless, SIRI have been insufficiently studied on Cayman Brac due to the inaccessible terrain and small iguana population (estimated at less than 500 adults). We obtained funds from Darwin Plus Local to validate the use of second-generation Wireless Sensor Nodes (WSNs) for the remote monitoring of at least 10 adult SIRI. The custom-made WSNs have been fundamental in defining migration routes, home range size, and habitat use in Critically Endangered Galápagos Pink Land Iguanas (*Conolophus marthae*). Our devices can be powered through miniaturized solar panels, batteries, or a combination of the two. They can collect accurate (±5 m) position data, temperature, humidity, UV light, etc., and even physiological parameters at user-specified time intervals. To transfer data, WSNs can rely on different communication protocols that exploit a satellite connection, local area internet networks, or cellular network technology. The resulting georeferenced information is crucial for informing conservation efforts, especially in identifying key areas of SIRI habitat. Combining georeferenced data with habitat maps can identify critical areas within the species' range (e.g., nesting and/or feeding grounds, and migration routes) for prioritization in conservation planning. Once identified, a GIS database will be developed and maintained by the Cayman Islands Department of Environment and the habitat will ultimately be proposed as new Terrestrial Protected Areas through the process stipulated in the National Conservation Act.

Impact of the Invasive Common Green Iguana (*Iguana iguana*) on the Agricultural Community in Puerto Rico

De Jesús Villanueva, Christina*[1], Gabriela Massanet Prado[2], William Gould[1], and Jason Kolbe[3]

[1]US Forest Service International Institute of Tropical Forestry, San Juan, Puerto Rico, USA; [2]Independent, Ponce, Puerto Rico, USA; [3]University of Rhode Island, South Kingston, Rhode Island, USA

As the Common Green Iguana's (*Iguana iguana*) non-native distribution continues to broaden, economic justification for the mitigation and management of introduced populations becomes increasingly important. In our work, we used farmer interviews to explore the impact of the

Common Green Iguana on crop production in Puerto Rico. From these interviews, we identified small-scale farms that had lost upwards of 20,000 dollars in a year due Common Green Iguana-caused crop loss. Farmers identified 32 crops impacted by the Common Green Iguana, including economically important squashes, tubers, and fruit. Farmers also identified hunting, crop-rotation, use of dogs and cats, fencing, and chemical deterrents as strategies to deter Common Green Iguanas from coming into their fields. From these results, we further studied the efficacy of chemical deterrents (use of Neem oil) and fencing as mitigation measures for Common Green Iguana impact on crop production. We found that in one of two field sites where crops were grown and harvested using these mitigation strategies, crop production in cucumber doubled when fences were used. With this work, we provide a starting point from which to estimate the financial cost of the Common Green Iguana in crop production. We expect that other members of the Iguana Specialist Group will benefit from this baseline when estimating the potential economic cost of invasive iguanas as a conversation point with their regional law makers.

Genetic Perspectives on Three Successful Conservation Translocations of the Turks and Caicos Rock Iguana (*Cyclura carinata*)

Dykema, Zach*[1], Giuliano Colosimo[2], Mark Welch[1], and Glenn Gerber[3]

[1]Mississippi State University, Starkville, Mississippi, USA; [2]University of Rome Tor Vergata, Rome, Italy; [3]San Diego Zoo Wildlife Alliance, Escondido, California, USA

We assessed genetic variation in translocated populations of the endangered Turks and Caicos Rock Iguana (*Cyclura carinata*). Small islands have limited resources, which constrains populations of terrestrial vertebrates to low census population sizes. Small population size correlates with a limited gene pool, thus low genetic variation should be anticipated in smaller populations due to genetic drift. However, newly established translocated populations should exhibit similar levels of genetic variation to that present in the source population used as genetic stock for their establishment. To assess whether the establishment of three translocations have been affected by genetic drift, genetic variation in translocated populations established on Six Hills Cay, French Cay, and two of the Bay Cays in the Turks and Caicos Islands were compared to that of their source populations on Big Ambergris Cay and Little Water Cay. We used 24 microsatellites and fragment analysis to genotype 259 iguanas across multiple generations following translocation. Allele frequencies and AMOVA revealed that genetic diversity has been maintained across these translocations, thus genetic drift has had no significant effect. This research helps determine how much genetic variation persists in small, translocated populations. Translocation has become a popular tool among conservationists and research supporting the efficacy of translocations is warranted.

Spring Space Use of Adult Female Útila Spiny-tailed Iguanas, *Ctenosaura bakeri*

Harding, Court*[1], Maria Celeste Molina Zavala[2], and Josiah Townsend[1]

[1]Indiana University of Pennsylvania, Indiana, Pennsylvania, USA; [2]Útila Iguana Research and Breeding Station, Útila, Bay Islands, Honduras

Protection of endangered species needs to include conservation and management of the species, its core habitat, and movement corridors. Adult females of many species may move from wetlands to terrestrial habitat, including amphibians, reptiles, and birds. We studied the space use and movement patterns in a population of the Critically Endangered Útila Spiny-tailed Iguana, *Ctenosaura bakeri*, a mangrove specialist endemic to Útila, Honduras. The Útila Spiny-tailed Iguana is threatened by habitat loss, poaching, pollution, and invasive species. We focused our efforts on the developed eastern half of Útila where as much as 20% of the population of this species occurs. We used radiotelemetry to track 18 adult female iguanas during the nesting season from March to May 2023. Iguanas were located in the canopy 52.66% of the time and hiding in cavities 40.41% of the time when relocated. On average, the tracked Útila Spiny-tailed Iguana's total home range was 850.43 ± SD 672.02 m^2 (95% autocorrelated kernel density estimator). Sixteen pairs of iguanas overlapped within their home range (n = 13 individuals). The average spring occurrence distribution was 8084.83 ± 9480.29 m^2 (95% dynamic Brownian bridge movement model). Adult females migrated 368.57 m (n = 7; range = 146–659) through undisturbed mangrove forests to coastal beaches to nest. We recorded nest locations at two communal sites in southeastern Útila. Body size did not affect space use or migration distances, but the more frequent use of cavities correlated with a smaller total home range size. Our results provide greater insight into the spring movement patterns and behavior of adult female Útila Spiny-tailed Iguanas.

Updates on the Útila Spiny-tailed Iguana Action Plan and Conservation Outreach

Maryon, Daisy* and Nicholle Gomez

Kanahau Wildlife Conservation Organization, Útila, Bay Islands, Honduras

The Útila Spiny-tailed Iguana (*Ctenosaura bakeri*) is a Critically Endangered species of iguana found only on the small (41 km^2) Honduran Island of Útila. Locally it is known as the Swamper as it is a mangrove specialist. The iguana occupies just 6.4 km^2 of mangrove forest with a population of ~5,000 Individuals. The species is threatened by invasive raccoons, illegal hunting, and habitat destruction. In 2019, a workshop was held at the annual Iguana Specialist Group meeting, where a conservation action plan was created for the protection of the species. In this talk, we will present actions completed and ongoing since the plan was implemented, including research, environmental education and outreach, and invasive species removal.

Genetic Variation and Origin in the Common Green Iguana Population of South Florida: Does Admixture Facilitate Successful Invasions?

Mitchell, Blaklie*[1], Mark Welch[1], Joe Wasilewski[2], Susannah French[3], and Sean Perry[4]

[1]Mississippi State University, Starkville, Mississippi, USA; [2]Natural Selections of South Florida, Princeton, Florida, USA; [3]Utah State University, Logan, Utah, USA; [4]Mississippi Aquarium, Gulfport, Mississippi, USA

The Common Green Iguana (*Iguana iguana*) is a prolific invasive with multiple non-native populations established throughout the world. Within the USA, the species was introduced to South Florida in the 1960s, consequent of the pet trade. For the first few decades following their introduction, non-native iguana numbers remained low. However, in recent years, the range and density of the Florida population has expanded dramatically. Invasive iguanas impose substantial economic costs, in addition to ongoing ecological damage, prompting local and state agencies to implement intensive management strategies. In this preliminary study, genetic variation was characterized and compared to that previously observed in the native range of the species to infer the origin(s) of the Florida population. Sequencing results suggest that most mitochondrial haplotypes originate from Central America. This evidence aligns with available documentation that shows a majority of pet-trade iguanas are sourced from Honduras, Panama, and El Salvador. Additionally, mitochondrial haplotypes from South America and the Lesser Antilles have also been discovered in Florida. This implies that hybridization, or admixture, between evolutionarily independent lineages of iguanas has likely occurred in this region. The capacity to adapt to novel environmental conditions, such as those encountered in non-native habitats, is highly dependent upon the degree of standing genetic variation within a population. Higher levels of standing genetic variation correspond with faster adaptation under natural selection, thus facilitating invasive establishment. Therefore, this preliminary study provides evidence to suggest that admixture may be promoting the rapid proliferation of the invasive Common Green Iguana population in Florida.

Population Status of the Spiny-tailed Black Iguana (*Ctenosaura bakeri*) in Útila, Bay Islands, Honduras in 2023

Narvaez, Suita* and Rosalia Argueta*

Bay Islands Foundation — Iguana Research and Breeding Station, Útila, Bay Islands, Honduras

The Spiny-tailed Black Iguana (*Ctenosaura bakeri*) is an endemic species to the island of Útila, Honduras, and was most recently evaluated in 2018 for the Red List of Threatened Species, being classified in the Critically Endangered category (IUCN 2023), due to the degradation of mangroves as its primary habitat, affecting the survival of its population. Útila has an estimated area of 886 hectares of mangrove (Flores 2022). In the conservation efforts of the species, the Bay Island Foundation – Iguana Research and Breeding Station, sought to estimate the main factors that affect the iguana population on the island of Útila, for which mangrove sampling was carried out in four sites during the years 2021, 2022, and 2023, traversing transects of 100 meters in length and recording the encounters of *C. bakeri* implementing the capture-recapture

methodology when possible. Data on the sex, life stage, total length, and weight of each captured iguana were recorded, and the temperature and relative humidity of the capture site were measured. Likewise, the type of ecosystem in which the iguana was found was determined. Each of the variables corresponding to the organism and ecosystem were taken into account to develop models of abundance and population density. The abundance of *C. bakeri* was mainly related to the type of ecosystem, being more abundant in the Turtle Harbor Wildlife Refuge, due to its diversity of habitats associated with wetlands. Likewise, the results indicate that the variables that most influenced the distribution of the iguanas were sex, temperature, and humidity.

Letting the Cat into the Bag: Responses of Feral Cats to Trapping Efforts and Management Implications in a Blue Iguana Reserve

O'Hehir, Sophie*[1], Bernardo Mesa[2], Luke Harding[3], Christine Proctor[2], Fred Burton[4], Markus Mueller[1], and Stuart Townley[1]

[1]University of Exeter, Penryn, Cornwall, UK; [2]Harrisburg University, Harrisburg, Pennsylvania, USA; [3]Blue Iguana Conservation, George Town, Grand Cayman, Cayman Islands; [4]Cayman Islands Department of Environment, George Town, Grand Cayman, Cayman Islands

Grand Cayman Blue Iguanas (*Cyclura lewisi*) in Grand Cayman are captive-bred and released into one of three reserves, two of which are isolated and large (77 and 261 hectares). Wild-hatched iguanas experience low survival rates, attributed to possible feral cat (*Felis catus*) predation. Feral cat population dynamics, spatial use, and removal responses have not yet been determined in Grand Cayman. As cat eradication in Grand Cayman is not currently feasible, feral cat population control in the reserves needs to be undertaken to possibly increase wild Blue Iguana hatchling survival. Our aim was to use a camera trap array to monitor a before-and-after effort to remove feral cats from the Salina Reserve. To determine the effectiveness of this management action, we implemented a density estimation using spatially explicit capture-recapture and population removal modelling. We removed a total of five feral cats in 180 trap nights. We observed no change in feral cat density before and after removal (mean ± SE, 7.18 ± 2.76 vs. 7.4 ± 3.35 cats/km^2). We identified spatial placement of traps as the factor contributing most to the capture rate, with only ~15% of the cats in the study area exposed and likely to be caught in traps. The linear relationship between larger activity range and increased probability of capture also explains the male bias in captures, as male cats have been recorded to roam farther. The rate of captures increased from 3% to 7% after 100 m, which we concluded as the most resource-effective distancing to increase the chances of cat capture. We were unable to determine cat immigration rates within a reserve after removal. This is necessary to establish intensity of removal sessions in order to maintain a lower density of cats, or if these current methods are sufficient to allow survival of hatchlings to adulthood.

Genomic Data Reveal Island Colonization Patterns for Endangered and Iconic Galápagos Iguanas

Paradiso, Cecilia*[1,2,3], Paolo Gratton[1], Julia López-Delgado[3], Emiliano Trucchi[4], Giuliano Colosimo[1], Ian M. Carr[5], Mohd Firdaus Raih[6], Mohd Noor Mat Isa[7], Christian Sevilla[8], Marco Gargano[1], Lorenzo Garizio[1], Simon J. Goodman[3], Mark Welch[2], and Gabriele Gentile[1]

[1]University of Rome Tor Vergata, Rome, Italy; [2]Mississippi State University, Starkville, Mississippi, USA; [3]University of Leeds, Leeds, UK; [4]Università Politecnica delle Marche, Ancona, Italy; [5]Leeds Institute for Molecular Medicine, University of Leeds, Leeds, UK; [6]Universiti Kebangsaan Malaysia, Bandar Baru Bangi, Selangor, Malaysia; [7]Malaysia Genome Institute, Kajang, Malaysia; [8]Galápagos National Park Directorate, Puerto Ayora, Galapagos Islands, Ecuador

Galápagos iguanas have always been a source of fascination for researchers and have become icons of evolutionary biology. The taxon started diversifying about 4.5 million years ago, with two genera and four named species currently described. The current distribution of these species taxa is thought to result from a combination of local extinctions and colonizations followed by local adaptation, genetic drift, and even evidence of hybridization. To disentangle the history of colonization and the evolution of these taxa, we initially focused on the current distribution of two syntopic species, *Conolophus subcristatus* and *C. marthae*. Previous phylogenetic analyses indicated the latter as the basal species of the land iguana genus, even though it shows an extremely restricted geographical distribution. We hypothesized that *C. subcristatus* slowly colonized different islands of the Galápagos, progressively out-competing and restricting the historically larger geographical range of *C. marthae*. To test this hypothesis, we performed demographic reconstructions using RAD sequencing data. We used a demographic reconstruction algorithm (StairwayPlot2) designed to infer recent historic changes in effective population size (N_e). *Conolophus marthae* shows evidence of a recent demographic decline, which roughly coincides with demographic growth in the sympatric population of *C. subcristatus*, consistent with the hypothesis of competitive interaction between the two species. This hypothesis will be further tested using a whole genome sequencing technique. This project will further contribute to an ongoing international initiative seeking to construct genome sequences for the Galápagos iguanas allowing for additional research and more informed conservation management plans for these vulnerable and threatened species.

Conservation of the Jamaican Rock Iguana, *Cyclura collei*

Pasachnik, Stesha*[1] and David Reid[2]

[1]Fort Worth Zoo, Texas, USA; [2]National Environmental Planning Agency, Kingston, Jamaica

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 reintroduction, 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 natural population growth. Recently, efforts have greatly improved the program. The headstart facility at the Hope Zoo in Kingston has been expanded, now having the capacity to house 50% of the annual hatchlings. The turnover rate within the headstart facility has decreased and over 600 individuals have been released back into the wild. Intensive research efforts within the Hellshire Hills have occurred over the past six years and a buffer zone has now been installed that more than doubles the protected area. This will ensure the level of protection needed for natural recruitment and population growth. Novel nest sites have been identified and protected, and hatchlings from these sites have been incorporated into the headstart program to ensure enhanced genetic diversity of the wild population. Outreach and education activities are bolstered with collaboration from local organizations. Together these actions have greatly enhanced the program and opened to door for continued improvement.

Jamaican Iguana (*Cyclura collei*) Health Assessment Update on Headstarted Iguanas at the Hope Zoo

Rainwater, Kimberly*[1], Szarianne Khan[2], Catherine McClave[3], Emily Freeman[1], Joseph Brown[2], Tandora Grant[4], and Stesha Pasachnik[1]

[1]Fort Worth Zoo, Texas, USA; [2]Hope Zoo, Kingston, Jamaica; [3]The Fish Doctor, Inc., Manasquan, New Jersey, USA; [4]San Diego Zoo Wildlife Alliance, San Diego, California, USA

Annual health assessments have been conducted on headstarted Jamaican Rock Iguanas (*Cyclura collei*) at the Hope Zoo for over two decades. Because the number of hatchlings brought into the facility has increased dramatically in recent years, optimizing health assessment procedures to balance efficiency, resource availability, and relevance to survivorship of released iguanas is important to the continued success of this program. Physical examination and blood parameter data from 2017–2020 were analyzed to create species-specific hematology, plasma biochemistry, protein electrophoretogram, blood gas panel, vitamin D3, and trace nutrient reference intervals where possible to aid in evaluating health status of *C. collei* in the future. In early 2023, health assessment procedures were performed on 403 iguanas, including a female 32-year-old long-term zoo resident. Physical examinations were performed on 99.5% (401/403) and blood was collected from 49.1% (198/403). Medical issues were seen in 3.2% (13/403). One female, approximately six months old, died, and a post-mortem examination was performed finding *Entamoeba* sp. cysts (3,918 cysts/g) in the feces. Quantitative fecal examinations on 11 samples found Pharyngodonidae oxyurids (3 – 8,496 eggs/gm) and *Nyctotherus* sp. ciliates (0–192 cysts/gm). Ectoparasites (ticks) were seen on 2% (8/403). Coelomic ultrasonography was used to evaluate gonads in 86 females and four males. Testes were not visualized, which is consistent with decreased testis size outside of the breeding season. Follicular activity was seen in many of the females scanned, and one was found to have a retained egg. A large, firm mass palpated in the coelomic cavity of a seven-year-old male was diagnosed as a bladder stone and removed surgically. That iguana was successfully released in May2023. Adding ultrasonography to the health assessment process was time-consuming but can improve diagnostic sensitivity for intracoelomic abnormalities relevant to reproductive fitness and would be helpful to include in future health assessments.

Response of the Chuckwalla *Sauromalus varius* to Harsh Temperature in the Hottest Month of the Year

Reynoso, Victor Hugo*[1], Melissa Plasman[2], Aníbal H. Díaz de la Vega-Pérez[3], and Marshall D. McCue[4]

[1]Universidad Nacional Autónoma de México, México City, México; [2]Universidad Rosario Castellanos, México City, México; [3]Universidad Autónoma de Tlaxcala, Tlaxcala, México, [4]Sable Systems, Las Vegas, Nevada, USA

The heating of the planet through anthropogenic climate change may have devastating effects on the herbivorous iguanas of desert islands. Currently, these iguanas already must cope with high environmental temperatures and are unable to escape to more suitable areas. In the Gulf of California, México, many islands have iguana species endemic to that single island. This area is one of the hottest in the world with air temperatures that can reach above 50°C in the summer. In ongoing research, we investigate the capacity of the Chuckwalla *Sauromalus varius* to respond to temperature in the hottest month of the year (July) on San Esteban Island, in the Gulf of California, México.

We found that, at capture, the iguanas had field body temperatures much lower than the environmental temperatures reached in the sun, especially considering the hot sand or rock surfaces. Interestingly, the temperature at which an iguana sought refuge in the shade was only slightly above their field body temperature. Even so, we found that the iguanas could endure much higher body temperatures. However, maintaining those high body temperatures was likely harmful, as the iguanas opened their mouths (which helps lose heat through evaporation, but also implies a loss of water, a scarce resource), and produced feces. Furthermore, in some iguanas, we observed sudden, rapid movements of the head, which could be small seizures caused by heat stress.

Our research shows that even though the iguanas can temporarily endure higher body temperatures, this is an improper response to climate change as it comes with great survival costs. These iguanas already spend much time in the shade and refuges and will likely need to increase that time even further, impeding foraging and declining their energy budget in this already hostile environment.

"Seed Shielding", a Newly Described Process That Prevents Seeds From Dying in Extreme Hot Conditions

Reynoso, Victor Hugo*[1] and Hugo Salinas[2]

[1]Universidad Nacional Autónoma de México, Ciudad de México, México; [2]The University of Western Australia, Perth, Australia

Sun exposure is a major threat to the survival of seeds in hot environments. During the summer, *Pachycereus pringlei*, a columnar cactus native to San Esteban Island in northwestern Mexico, produced succulent fruits from which the herbivorous iguanas *Ctenosaura conspicuosa* and

Sauromalus varius fed. After digestion, seeds within their feces are deposited on the ground and exposed to the sun at different degrees according to the site where the seeds lay. Also, seeds that are not consumed fall to ground after the fruits ripen and open. To evaluate the effect of seed shielding to seed germination, we measured the germination rate of: 1) wild seeds exposed to the sun collected directly on the soil; 2) seeds harvested directly from the fruit without sun exposition; 3) seeds obtained from old iguana scats with some sun exposition; and 4) seeds obtained from newly deposited iguana scats with little sun exposition. Our results show that direct exposure to sunlight significantly reduces seed germination, and that scat protection attenuates this negative effect, although germination rates of seeds stored in feces becomes lower. We discuss some possible implications of seed protection for *P. pringlei* populations.

Galápagos Iguanas: An Insight Into Diving Ability Evolution

Rahim, Mohd Syafiq*[1], Giuliano Colosimo[1], Paolo Gratton[1], Mohd Firdaus-Raih[2], and Gabriele Gentile[1]

[1]University of Rome Tor Vergata, Rome, Italy; [2]Universiti Kebangsaan Malaysia, Bandar Baru Bangi, Selangor, Malaysia

The Galápagos Islands is home to four different endemic species of iguanas. Three of them, *Conolophus marthae*, *C. subscristatus* and *C. pallidus*, are terrestrial while the fourth, *Amblyrhynchus cristatus*, has adapted to marine life. We used genomic data to understand the evolutionary history of these species. We started unraveling their relationships by investigating one of the ecological characteristics setting apart the terrestrial from the marine species: the evolution of diving adaptation. We focused on hemoglobin (Hb) as a candidate gene for this study. Four globin subunit genes were identified in *A. cristatus*, *C. marthae* and *C. pallidus*: alpha (α)-A, α-D, β-(β1) and β2-subunit. Both iguanas are believed to have two Hb isoforms, HbA and HbD encoded by α-A and α-D gene subunit, respectively. With the presence of the two β-subunits, three oligomeric states were predicted: (1) α2β12, (2) α2β22, and (3) α2β1β2. We used root mean square fluctuations (RMSF) and Principal Component Analysis (PCA) on molecular dynamics (MD) simulations to elicit different stability in each tetramer per species. The simulated tetramers also showed different persistence of hydrogen and salt bond formation over each predicted structures per species. Furthermore, analyses of the interactions energy of Hb structure with allosteric phosphate for iguana (ATP) showed different deltaG for predicted proteins. Our results provide an insight into molecular level interactions allowing for specific Hb-mediated diving adaptations and can be used to further understand the evolution of diving and marine foraging behavior.

Iguanas Saved Me: Can Writing Help Save Them?

Townsend, Wendy*

Independent, Callicoon, New York, USA

I'll begin with why and how I came to writing about iguanas, the obstacles I've met in publishing, and close with my thoughts about using stories to promote iguana conservation. My lizard love predates memory.

To show my earliest identity with lizards, and my first awareness of rock iguanas, I'll read a brief excerpt from a memoir-in-progress: Lizards Saved Me. Iguanas got me through hard childhood circumstances and were my beacon every time I lost my way. From the east coast to the west coast and back again, my iguanas saw me through countless jobs and four colleges, trying to be a biologist but finally accepting that I had to write, and then I understood how my lizard love was not a hobby, but central to my life and my happiness.

But what could I do to save iguanas? A colleague read some of the memoir and said, "I don't even like lizards, but you make me love them in these parts." That is what I strive for when I write, and everything I write is ultimately a plea for conservation. I've written books, essays, and opinion pieces including a Young Adult novel about the seven Grand Cayman Blue Iguanas killed at the QE II Botanic Park in 2008, and an op-ed about Jamaica's Goat Islands crisis in 2014. I've been, so far, unable to publish a book about the Jamaican Rock Iguana. Doors start to open when I write about my own experiences with animals and nature. We all have stories about why and how we came to iguana conservation, and of course stories inspire people, especially children. I will hopefully get us all thinking about using writing to bring iguanas closer to readers as a way of "moving the needle" in iguana conservation.

Safeguarding Iguana Diversity: Tracking Invasive Species' Impacts With Terrestrial eDNA Innovations

van Kuijk, Jeroen*[1], Matthijs van den Burg[2], Mark de Boer[3], Adolphe Debrot[4], and Kat Stewart[1]

[1]Institute of Environmental Sciences, Leiden University, The Netherlands; [2]Burg Biologica, Den Hague, The Netherlands; [3]Diergaarde Blijdorp, Rotterdam, The Netherlands; [4]Wageningen Marine Research, Wageningen University and Research, Den Helder, The Netherlands

Reptiles have among the highest threat status and risk of extinction of all terrestrial vertebrates, with habitat fragmentation, destruction, and Invasive Alien Species (IAS) being the primary causes of reptile species' loss on a global scale. In particular, IAS have far-reaching implications for biodiversity, including competition, disease, displacement, and hybridization with native species, all driving increasing extinction rates. Invasive hybridization is increasing globally due to anthropogenic impacts, and nowhere is this more omnipresent than among Caribbean iguanas. The Lesser Antillean Iguana (*Iguana delicatissima*), an important keystone species for Caribbean coastal ecosystems, is in part Critically Endangered due to rampant and rapid hybridization with the invasive Common Green Iguana (*Iguana iguana*). In this study, we

developed a novel environmental DNA (eDNA) toolkit for cost-effective and efficient sampling of sample terrestrial vegetation in St. Eustatius to map the distribution of native *I. delicatissima*, invasive *I. iguana*, and signal invasive hybridization. This toolkit managed to successfully detect the presence of *I. delicatissima* in several *ex situ* samples collected while using environmental swabs, tape-lifting, and rainwater collection. We found that sampling potential perching spots yielded the highest number of positive detections via environmental swabbing and tape lifting. This toolkit is the first of its kind to demonstrate terrestrial eDNA sampling for iguana conservation, enabling a faster identification for invasive hybridization management.

Nest-site Selection of *Cyclura carinata* Across a Gradient of Anthropogenic Disturbance

Wehsener, Jimmy*[1], Mark Welch[1], and Glenn Gerber[2]

[1]Mississippi State University, Starkville, Mississippi, USA; [2]San Diego Zoo Wildlife Alliance, Escondido, California, USA

We examined nest-site selection of the endangered Turks and Caicos Rock Iguana (*Cyclura carinata*) at multiple spatial scales on the island of Big Ambergris Cay (BAC). Extirpated from 90% of its historic range, the largest remaining population now resides on BAC. The population has declined 30–40% in the 25 years since the island started being developed, but numbers are currently stable. Thus, it provides a unique opportunity to study nesting ecology on a human-inhabited island that still supports an intact iguana population. Since development on BAC will continue, the findings of this study could prove critical to the long-term security of this species. The probability of iguanas selecting specific habitat for nesting was modeled using binary logistic regression. Six different major habitat classes are present on the island: non-vascular, herbaceous, dwarf shrubland, shrubland, woodland, and human-altered. Points were generated across the island using a random number generator to compare the habitat attributes to those at nest locations. We identified two habitat types that were significantly selected for by nesting females—they contained over 80% of our nest points yet comprise only a third of the island. These areas are critical to the survival of the species and should be prioritized for preservation. We also modeled microhabitat preferences as characterized by variables, including vegetation type and coverage, and soil moisture and compaction. At this finer spatial scale, random points for comparison were generated from within the potential nesting site, defined by a minimum convex polygon connecting nest coordinates at each study site. From this, we constructed a predictive model that will aid in prioritizing, and perhaps discovery, of critical habitat on BAC. Given similarities in nesting ecology across taxa, a continuation of this work may inform conservation efforts and real estate development in the Caribbean where *Cyclura* are present.

POSTER PRESENTATION ABSTRACTS

POSTER: **Unmasking the Menace: Invasive Raccoons (*Procyon lotor*) as an Emergent Threat to Biodiversity on Útila Island, Honduras — First Glimpse of Eradication Efforts' Impact**

Brown, Tom*, Nicholle Amador Gomez, and Daisy F. Maryon

Kanahau Wildlife Conservation Organization, Útila, Bay Islands, Honduras

Unveiling the initial results from the invasive species management plan for Raccoons (*Procyon lotor*) on Útila. First identified as an emergent threat in the IUCN Action Plan for the Útila Spiny-tailed Iguana (*Ctenosaura bakeri* 2020–2025), immediate steps were taken to research and combat the invasion of Raccoons on the island. From 2021–2022, we designed and obtained support for a strategic eradication and biosecurity protocol, and solicited legal permissions to live-capture and ethically dispatch Raccoons. In 2023, we obtained partial funding to begin implementing the eradication project and purchasing the required equipment. Here, we compile the evidence justifying the negative impact of Raccoons on iguana and native wildlife, as well as the capture data and removal rates of this invader from within various habitats across the island.

POSTER: **Trabajo Conjunto para la Conservación de la Iguana Swamper (*Ctenosaura bakeri*) en la Isla de Útila**

Delarca, Geyvy*

Instituto de Conservación Forestal, Áreas Protegidas y Vida Silvestre, Útila, Honduras

El Instituto de Conservación Forestal, es una institución del Estado Hondureño responsable de la administración y manejo de los recursos forestales, las áreas protegidas, y la vida silvestre, mediante la aplicación de instrumentos normativos y reguladores para su protección, restauración, aprovechamiento, fomento y conservación, en beneficio de la población Hondureña. A través de Proyecto Fortalecimiento al SINAPH (Life Web Initiative), se ejecutan acciones de conservación de la Swamper, siendo objeto de conservación del plan de manejo. Se realizan acciones como ser: investigación del estado poblacional, acciones de prevención de incendios y cacería, así como la implementación de un plan de educación ambiental, y un plan de erradicación de especies invasoras. También se realizo la Creación de Comité técnico interinstitucional, mediante el cual se gestionan todos los temas relacionados al área protegida y sus objetos de conservación. A la vez se gestiono, el financiamiento del Plan Operativo Bianual del Refugio de Vida Silvestre Turtle Harbour para el periodo 2023-2024.

Dentro de las funciones para la conservación de la Swamper, el ICF, a través de la oficina local, apoya logística mente en los preparativos para la celebración anual del Festival Save the Swamper, siendo el 2023 el tercer año consecutivo en el que Kanahau y FIB realizan este importante evento.

POSTER: **The Effects of a High Sugar Diet on Immunity in the Common Green Iguana, *Iguana iguana***

French, Susannah*[1], Kwanho Claudia Ki[1], Erin Lewis[1]; Elizabeth Wu[2], Francis Oliaro[3], Lise Aubry[4], Charles Knapp[3], Karen Kapheim[1], and Dale DeNardo[2]

[1]Utah State University, Logan, Utah, USA; [2]Arizona State University, Tempe, Arizona, USA; [3]John G. Shedd Aquarium, Chicago, Illinois, USA; [4]Colorado State University, Fort Collins, Colorado, USA

Intentional feeding of wildlife is an increasingly popular activity; it is especially popular in the ecotourism industry where tourists are offering unnatural food items. However, these food items generally lack nutrients and are high in carbohydrates, and the downstream physiological effects of altering diet and nutrition from what is found in nature are still unclear. We tested the effects of a high sugar diet on the immune function of captive Common Green Iguanas (*Iguana iguana*) to investigate the physiological effects of an altered diet on immunity. Specifically, we sought to understand if a high sugar diet compromised immune competency relative to a standard diet and whether it affected the sequential immune response to either primary or secondary controlled immune challenges. We used a 2x2 design manipulating immunity and sugar, where dextrose was administered daily for 30 days before the immune challenge, and then continued during both primary and secondary immune challenges. We found significant effects of sugar on the immune system that varied depending on the type of immunity and over time. This design allowed us to test the causal relationships between diet and immunity and the possible implications for animal health in general. Overall, these findings will help us better understand the effects of dietary changes on the immune system as it is understudied in non-model organisms, and may inform feeding of wildlife.

POSTER: **Population Status of the Spiny-tailed Black Iguana (*Ctenosaura bakeri*) in Útila, Bay Islands, Honduras in 2023**

Narvaez, Suita* and Rosalia Argueta*

Bay Islands Foundation — Iguana Research and Breeding Station, Útila, Bay Islands, Honduras

A poster will be presented that outlines the content of the author's oral presentation above.

POSTER: **A Literature Review of Microbiome Diversity of Iguanas**

Zarza, Eugenia*

El Colegio de la Frontera Sur, Tapachula, Chiapas, México

Understanding the complexity of microorganisms associated with animals is important because it provides clues on host-microbiome evolution, adaptation, zoonosis, etc. Interest in studying the microbiome of wild, urban, and captive animals has increased in recent years thanks to the development of high-throughput sequencing. These culture-independent studies have already offered an initial view of the role of bacteria in adaptation to: human-altered habitats (e.g., urbanization), human activities (e.g., tourism), and human interventions for conservation (e.g., headstart reintroduction programs) in iguanas and other reptiles. Microbiome studies are greatly affected by sampling strategies, sample preservation methods, PCR conditions, sequencing and bioinformatic strategies, etc. I will summarize the taxonomic spread of published works, what are the questions pursued, and what we know so far about the microbiome of iguanas. I will explore the commonalities of the microbiome studies and analyze if it is possible to perform a comparative analysis of the studies on iguanas published so far. I will offer possible research perspectives that are relevant for conservation, adaptation to anthropomorphized environments, and medical implications for zoonosis and the spread of antibiotic resistant genes.