

**IUCN SSC Crocodile Specialist Group
Regional Meeting
Latin America and the Caribbean**



Program and Abstracts

26-29 June 2019

Placencia, Belize

June/Junio 26 - Regional Status Update / Informes de Estados Regional

7:00	Registration / Registro
9:00	Opening Ceremony / Bienvenida y Ceremonia de apertura
9:30	What is the CSG / ¿Qué es el CSG? - Grahame Webb
9:50	Keynote Speaker / Presentación Principal - Alvaro Velasco
10:30	Break / Descanso
10:50	Belize Status Update / Informes de Estado
11:10	Costa Rica Status Update / Informes de Estado
11:30	Cuba Status Update / Informes de Estado
11:50	French Guiana Status Update / Informes de Estado
12:20	Lunch / Almuerzo
14:00	Guatemala Status Update / Informes de Estado
14:20	Guyana Status Update / Informes de Estado
14:40	Honduras Status Update / Informes de Estado
15:00	Jamaica Status Update / Informes de Estado
15:20	Break / Descanso
15:40	Nicaragua Status Update / Informes de Estado
16:00	Panama Status Update / Informes de Estado
16:20	Trinidad and Tobago Status Update / Informes de Estado
16:40	El Salvador, Puerto Rico, Suriname, Dominican Republic, Haiti Status Update / Informes de Estado
17:00	Coins for Crocodiles - Colette Adams
18:30	Dinner and drinks / Cóctel y cena

June/Junio 27 - Conservation and Management / Conservación y Ordenación

9:00	Keynote Speaker / Presentación Principal - Juan Bolaños
9:40	Reintroducción del cocodrilo cubano <i>Crocodylus rhombifer</i> en el refugio de fauna “Canales Hanabana” de la Ciénaga de Zapata, Cuba. - Toby Tagarona
10:00	Population status of the Morelet's crocodile (<i>Crocodylus moreletii</i>) in Belize. - Jonathan Triminio
10:20	Break / Descanso

10:40	Population survey of <i>Caiman crocodilus</i> and <i>Crocodylus acutus</i> in Rio San Juan, Nicaragua. - Miriam Boucher
11:00	Assessment of the Black Caiman (<i>Melanosuchus niger</i>) Appendix I CITES Status in Guyana. - Adonika Spellén
11:20	Designing, Constructing and Maintaining a Crocodile Sanctuary in St Thomas Jamaica - Joe Wasilewski
11:40	Assessing the status and potential reintroduction of the critically endangered Cuban crocodile in the Lanier Swamp, Isla de la Juventud, Cuba, - Gustavo Sosa Rodríguez
12:00	Crocodylians as indicator species: implications for Latin America and the Caribbean. - Jennifer Nestler
12:20	Lunch / Almuerzo
13:30	Keynote Speaker / Presentación Principal - Pablo Siroski
14:10	Conservation status of the <i>Caiman crocodilus fuscus</i> in the Bayano River Basin, Republic of Panama. - Melciellyne Aguilar
14:30	Conservation Status and Proposal of a Management Plan for the Rancho of Spectacled Caiman (<i>Caiman crocodilus chiapasius</i>) In "La Encrucijada" Biosphere Reserve, Chiapas, Mexico. - Carolina Sanchez-Arias
14:50	Abundance and population structure of the Morelet's Crocodile (<i>Crocodylus moreletii</i>) in the region of Calakmul, Campeche, Mexico. - José Barão-Nóbrega
15:10	Break / Descanso
15:30	Assessing the health of the Cuban crocodile population at the Zanja del Diez, Zapata Swamp, Cuba. - Gustavo Sosa Rodríguez
15:50	Population Assessment of the Genus <i>Crocodylus</i> in the Zanja del Diez, Zapata Swamp National Park, Cuba. - Etiam Pérez Fleitas
16:10	State of habitat and population ecology of crocodiles and alligators Gulf of Montijo Wetland. - Staphany Del Rosario
16:30	Spectacled caiman (<i>Caiman crocodilus</i>) removal in southern Florida, USA. - Sidney Godfrey
16:50	Conservation Benefits from Social Media Marketing. - Jen Brueggen
17:10	Poster Session / Sesión de Póster
18:30	Dinner and drinks / Cóctel y cena

June/Junio 28 - Scientific Investigations / Investigaciones Científicas

9:00	Keynote Speaker / Presentación Principal - Hesiquio Benítez
9:40	Use of visual and olfactory stimuli in prey selection by hatchlings Morelet's crocodile (<i>Crocodylus moreletii</i>). - Mariana González-Solórzano
10:00	Estimation of Predation Rate in Hatchlings of Morelet's Crocodile (<i>Crocodylus moreletii</i>) Using Clay Models. - Monserrat Gómez Torres
10:20	Break / Descanso

10:40	American Crocodile <i>Crocodylus acutus</i> Growth at Sumidero Canyon National Park, Chiapas, Mexico. - Luis Sigler
11:00	Case Study: Behavioral techniques applied to Wild Crocodiles and recent captured Crocodiles for rerelease in <i>C. acutus</i> - Flavio Morrissiey
11:20	Scale patterns of the American and the Morelet's crocodile in Southeastern Mexico . - Terry Mougard
11:40	Keeping Track: Satellite Transmitter Deployment on Crocodiles in Belize. - Miriam Boucher
12:00	Crocodile claws as a potential non-invasive biomarker of metal exposure. - Marisol Buenfil-Rojas
12:20	Lunch / Almuerzo
14:00	Concentrations of pollutants in sediment and in tissue of crocodiles (<i>Crocodylus moreletii</i>) of the Usumacinta river basin, Mexico. - Pierre Charuau
14:20	Factors Affecting Morelet's Crocodile (<i>Crocodylus moreletii</i>) Body Condition in Belize: Do Multiple Recaptures Result in Skinnier Crocodiles?. - Brittany Mason
14:40	Crocodile Conservation Program of the Municipality of Puerto Vallarta, Jalisco - Helios Hernandez
15:00	Chronology of heavy metals in sediments and determination of the concentration of these metals in sediment and scutes of <i>Crocodylus acutus</i> in marine-coastal environments of the Gulf of Chiriquí and Montijo. - Betzaida Rivera
15:20	Break / Descanso
15:40	Origin and evolutionary history of Banco Chinchorro saltwater crocodiles. - Jose Avilla-Cervantes
16:00	Tail Amputation in Cuvier's Dwarf Caiman <i>Paleosuchus palpebrosus</i> . - Luis Sigler
16:20	Closing Ceremony / Ceremonia de Clausura
18:30	Farewell dinner and drinks / Cóctel y Cena de despedida
June/Junio 29 - Workshop and Separate Excursion / Taller y Excursión Separada	
12:00	Departure for Monkey Bay Excursion / Salida del hotel a Monkey Bay para una excursión nocturna.
13:00	Workshop / Taller

What is the CSG?

The IUCN-SSC Crocodile Specialist Group (CSG; www.iucncsg.org) is a worldwide network of biologists, wildlife managers, government officials, independent researchers, non-government organization (NGO) representatives, farmers, traders, tanners, fashion leaders, and private companies actively involved in the conservation of the world's 27 living species of alligators, crocodiles, caimans and gharial in the wild. As one of more than 100 species specialist groups operating under the auspices of the Species Survival Commission (SSC) of the International Union for Conservation of Nature (IUCN), the world's largest consortium of conservation organizations and agencies, the CSG works closely with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and other international intergovernmental bodies to promote crocodilian conservation and legal trade that does not threaten the survival of these important reptiles. The CSG network of experts advises governments and wildlife management agencies, provides expert input to policy, evaluates the conservation needs of crocodilian populations, initiates research projects, conducts surveys of wild populations, provides technical information and training, initiates conservation programs, etc.

¿Qué es el CSG?

El Grupo de Especialistas en Cocodrilos de la UICN-SSC (CSG; www.iucncsg.org) es una red mundial de profesionales, administradores de vida silvestre, funcionarios gubernamentales, investigadores independientes, representantes de organizaciones no gubernamentales (ONG), dueños y empleados de criaderos, comerciantes, curtidores, líderes de la moda, y empresas privadas que participan activamente en la conservación de las 27 especies vivientes de cocodrilos, caimanes y el gharial, en el mundo. Como uno de los más de 100 grupos de especialistas en especies esta avalado por la Comisión de Supervivencia de Especies (SSC) de La Unión Internacional para la Conservación de la Naturaleza (UICN), el mayor consorcio mundial de organizaciones y agencias de conservación. Asimismo, el CSG trabaja en estrecha colaboración con la Convención sobre el Comercio Internacional de Especies Amenazadas de Fauna y Flora Silvestres (CITES) y otros organismos internacionales intergubernamentales para promover la conservación de los cocodrilos y el comercio legal sin poner en riesgo la supervivencia de estos importantes reptiles. La red de expertos que conforma del CSG aconseja a los gobiernos y las agencias de manejo de vida silvestre, proporcionan aportes para las decisiones políticas evalúan las necesidades de conservación de las poblaciones de cocodrilos, realizan proyectos de investigación y evaluar el estado de las poblaciones silvestres, brindan información técnica y capacitación, inician programas de conservación, etc

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FOREWORD

Regional Conservation Through Collaboration

At the CSG's 24th Working Meeting held in Skukuza, South Africa (2016), and 25 the Working Meeting in Santa Fe, Argentina (2018), Latin America and the Caribbean was recognized as a priority area with regard to crocodile conservation, particularly given the lack of available information and threats associated with habitat loss. There is an urgent need to identify local wildlife champions who can lead crocodile research and management in the sub-region, and help to build a robust network of stakeholders to ensure regional conservation of crocodilians and their habitat.

The theme for the CSG's sub-regional meeting is "Fostering Regional Conservation through Collaboration". The meeting aims to bring together and provide networking, collaboration and support opportunities for key stakeholders and experts. The meeting will showcase current knowledge on topics such as crocodilian management (i.e. human-crocodile conflict, scientific research, population survey techniques, habitat monitoring), sustainable use, and policy within the sub-region that will not only be beneficial for regional crocodilian conservation, but also for long-term management of biodiversity within crocodilian habitat.

Conservación regional a través de la colaboración

En las últimas dos reuniones mundiales de trabajo del CSG llevadas a cabo en Skukuza, Sudáfrica (2016) y Santa Fe, Argentina (2018), el Grupo Especialista identificó a América Latina y el Caribe como prioridad en lo que respecta a la conservación de los cocodrilos. Esta prioridad se debe a la falta de información regional y al conjunto de amenazas a las cuales están expuestos estos organismos como ser la acelerada destrucción y pérdida de su hábitat, entre otros. Es por eso que existe la urgente necesidad de identificar a los defensores locales de la vida silvestre que puedan asesorar y guiar a la sub-región de manera proactiva hacia el camino de la investigación y el manejo de los cocodrilos, construyendo al mismo tiempo una red sólida entre los diversos países y las diferentes partes interesadas para trabajar en pos de garantizar la conservación a nivel regional y el resguardo de sus hábitats naturales.

La temática propuesta para la reunión: "Conservación regional a través de la colaboración" permitirá crear un entorno transformador en donde las partes interesadas y los diferentes especialistas serán actores claves para el trabajo en red, generando nuevas y necesarias oportunidades, estableciendo de ese modo el apoyo y la colaboración en cuanto al aporte de un mayor conocimiento en lo que respecta a temas de estrategias de conservación y manejo, presiones existentes en relación a conflictos humanos-cocodrilos, la caza furtiva, el estado de los hábitats, el rol potencial de la industria basada en el uso sostenible y las políticas a nivel subregional. El tratado de estos enfoques no solo serán beneficiosos para la conservación regional de los cocodrilos, sino que también para el manejo a largo plazo de la biodiversidad dentro del hábitat de ellos.

ORGANIZERS AND SPONSORS

Regional Meeting Organizing Committee

Dr. Marisa Tellez	Cochair, planning, excursion, housing, registration, travel, workshop
Miriam Boucher	Cochair, planning, website design/upkeep, registration, travel
Tara Westby	Planning, housing, event Coordination, catering
Grecia Mendez	Planning
Valerie Garcia	Translation audio equipment
James Tamarack	Cox Lagoon excursion
Luis Sigler	Workshop
Pablo Siroski	Workshop

Donors and Sponsors

Crocodile Research Coalition
 Belize Forest Department
 The Placencia Hotel
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 Wildlife Discovery Center
 Ray Caye Island Resort
 Travellers Liquors Ltd.
 Barefoot Beach Bar
 Maya Beach Hotel and Bistro
 Jaguar Lanes Bowling
 Cha Chi's Pizza



June 26, 2019 – Regional Status Updates

The history of conservation, management and trade of crocodiles in Central America, Caribbean and Mexico

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Abstract

The Central America, Caribbean and Mexico are a sub region of the Crocodile Specialist Group (CSG), conformed by all countries from Mexico to Panama and the Caribbean islands. Only 39 members representing 8 countries of the sub region; 21 from Mexico, that's which means that only 18 persons represent Central America and the Caribbean. The sub regional representation on the Steering Committee (SC) start in 2005 and the representation change on time. Actually 5 steering committee members represent the region, Marissa Tellez (Central America), Laura Porras (Costa Rica), Manuel Tabet (Cuba), Hesiquio Benitez (Mexico), Manuel Muñiz (Industry), Alvaro Velasco (Regional Trade) and Pablo Siroski (Regional Chair) and one of the Deputy Chair of the CSG is Alejandro Larriera from Argentina. From 1991 every two years, 31 working meeting has been made in different parts of the world. In 22 of these events, was attended by 198 persons of the sub region (71%) and 180 speech and poster was presented. Also in the sub region has been celebrated regional, national workshops or meetings, 16 events has been realized. The CSG Newsletter has been published in 120 times and includes 209 notes from the sub region. Actually two organization still in activity in Central America, Caribbean and Mexico, The Costarican association of crocodile researches and Mexican Crocodile Specialist Group in Mexico. Other sub regional crocodiles activities are the training courses in management, conservation and sustainable use carried out in Mexico and Costa Rica.

Five crocodiles species are in Central America, Caribbean and Mexico, *Caiman crocodilus* (*C. c. crocodilus*, *C. c. fuscus* and *C. c. chiapasius*), *Paleosuchus palpebrosus*, *Crocodylus acutus*, *Crocodylus moreletii* and *Crocodylus rhombifer*. *Crocodylus acutus* is the specie with more management and programs, for conservation and sustainable by ranching (Cuba) and captive breeding (Cuba, Honduras and Mexico). *Crocodylus rhombifer* in Cuba and *Crocodylus moreletii* in Mexico are under captive breeding program. *Caiman crocodilus* sp. is under wild harvest in Nicaragua and in the pass by captive breeding program in Panama. The crocodile skin commerce start in 1984 in the sub region and continued during the time. *Caiman crocodilus fuscus* is the principal species on trade and so far in participation percent are *Crocodylus moreletii* and *Crocodylus acutus*. The sub region potential to create an important source of crocodile skins that produce economic benefits to each country and their communities is high. Management programs for sustainable use have been implemented and for different reason are stopped. Other option is use crocodiles for tourist attraction.

Coins for Crocodiles

Colette Adams

Gladys Porter Zoo, Brownsville, TX, USA

Abstract

It's no secret that there is no one a crocodile enthusiast would rather spend time with than someone else who shares their passion. CrocFest was borne on that premise. In 2009, a group of friends-in-crocs met in Florida, USA, to share food, drink and crocodile stories. Gathered around Ralf Sommerlad, an idea surfaced: if everyone contributed a little bit of money each time they got together, the funds collected could then be donated to a project for the benefit of imperilled crocodiles. An informal survey conducted of zoos in 2015 verified that crocs could use the help. At that time, only 0.03 percent of conservation funds raised for species preservation within the previous 5 years were earmarked for crocodilians.

Fast forward to 2019. CrocFest is now an event that takes place twice a year, and to-date has raised over \$417,000 USD for projects in 14 countries. This presentation shares information on the recipe for CrocFest as well as snapshots of the people who have made it successful.

June 27, 2019 – Regional Conservation and Management

Keynote Speaker – Juan Bolaños

Reintroducción del cocodrilo cubano *Crocodylus rhombifer* en el refugio de fauna “Canales Hanabana” de la Ciénaga de Zapata, Cuba

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Resumen

El cocodrilo cubano *Crocodylus rhombifer* es una especie en Peligro Crítico de Extinción, distribuida actualmente en 776 km² aproximadamente de la zona sur-occidental de la Ciénaga de Zapata y concentrada en un área núcleo de algo más de 300 km², simpátricamente con el cocodrilo americano y el híbrido de ambas especies. La caza comercial extirpó la especie en la zona oriental de la Ciénaga de Zapata, durante los últimos 100 años, en un territorio correspondiente al 30% de su distribución local histórica. Por esta razón y como un componente de la estrategia de la conservación del cocodrilo cubano, desde 2012 se comenzó a elaborar un programa de reintroducción del cocodrilo cubano en esta área, con la participación de varias instituciones, con el propósito de reestablecer una población silvestre viable y estable del cocodrilo cubano en un área donde la especie fue extirpada, según registros históricos de su distribución en la Ciénaga de Zapata, atendiendo los criterios establecidos por la Guía para reintroducciones de la Unión Internacional de la Conservación de la Naturaleza (UICN) y la información disponible de los programas de liberación de cocodrilianos realizados en Cuba y otros países. Se seleccionó el Refugio de Fauna “Canales de Hanabana”, situada en la región oriental de la Ciénaga de Zapata, con un área de 5646 ha, que tenía los requisitos necesarios para la liberación de cocodrilos. Este hábitat natural histórico de la especie fue alterado en la década del 60 con fines agrícolas y está formado por un sistema de canales, terrazas inundadas, parches de vegetación en los bordes de los canales y herbazal de ciénaga en los espacios entre canales, con abundante alimento. En enero del 2016 se realizó la primera liberación de 99 cocodrilos seleccionados en el criadero de la Ciénaga de Zapata: 11 machos y 88 hembras, con una edad entre tres y cinco años. El largo total promedio fue de 114,8 ± 14,9 cm (94-162) y un peso promedio de 7,3 kg ± 3,5 (4,0 – 19,5). El 71 % de los animales estaban entre 110 a 120 cm y en junio del 2017 se liberaron 10 ejemplares. El objetivo del trabajo es presentar los resultados durante los tres primeros años del programa y los problemas que han afectado. Se observó en el primer año una dispersión de hasta siete kilómetros del lugar de liberación y un crecimiento

mensual de $2,14 \pm 1,16$ cm (0,17-3,45; N = 7) y en segundo año, no se observaron ningún animal de esta liberación. La dispersión de la segunda liberación fue de un kilómetro y en diciembre del 2017 no se localizó ningún animal en las áreas muestreadas, aunque se observaron rastros, heces y asoleaderos. Las dificultades presentadas fueron que el monitoreo no se realizó con la intensidad y sistematicidad planificada, ausencia de transmisores, inundación y una protección eficiente. A pesar de los desafíos enfrentados, el buen crecimiento y adaptación de los animales liberados demostraron que el refugio de fauna “Canales Hanabana” es un hábitat con condiciones adecuadas y apta para el establecimiento de una población viable del cocodrilo cubano.

Nationwide Population Survey of the Morelet’s Crocodile (*Crocodylus moreletii*)

***Dr. Marisa Tellez, Miriam Boucher, and Jonathan Triminio**

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Abstract

The Morelet’s crocodile (*Crocodylus moreletii*) is currently listed as “Least Concern” under the International Union for Conservation and Nature (IUCN) Red List, and is listed on Appendix II of the Convention on International Trade in Endangered Species of Flora and Fauna (CITES) throughout its range. However, the CITES and IUCN status is based on data collected from *C. moreletii* in the 1990s in Belize, and may not reflect the current status. As the human–crocodile conflict rises in concomitance to human communities expanding and encroaching into crocodilian habitat, and crocodiles are in threat of pollution and habitat destruction, a modern management plan for the *C. moreletii* is highly warranted in Belize. The Crocodile Research Coalition (CRC) conducted a countrywide survey between 2016 – 2018 of *C. moreletii*, observing 1,327 crocodiles throughout over 987.98km (encounter rate = 1.3 crocodiles/km). Our methods included habitat monitoring, nocturnal eyeshine survey, capture and tag, nest survey, and community outreach. Tissue samples were taken for heavy metal and genetic analysis, as well as physical examinations were conducted on the 209 crocodiles captured during this study. Capture surveys proved difficult as many crocodiles were highly weary, likely reflecting continual persecution and hunting similar to the original studied conducted in 1997. The increase in adults and subadults is a positive sign that the population is growing, however, the larger number of juveniles observed indicates a population is still in recovery and has not stabilized. Primary threats identified for the species are habitat destruction and pollution. During community outreach events, CRC identified 3 common concerns by people based on false facts or misguided information on crocodiles. Data from this survey will assist Forest Department in creating the 1st conservation and management program for the Morelet’s crocodile in Belize.

Population survey and conservation considerations for spectacled caiman and American crocodiles in Rio San Juan, Nicaragua

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Abstract

We conducted spotlight counts January – February 2019 to determine the population status of spectacled caiman (*Caiman crocodilus*) and American crocodiles (*Crocodylus acutus*) in the south west of Rio San Juan department, Nicaragua. Over 15 consecutive nights of spotlight counts we covered a total of 202.2 km and encountered a total of 1277 spectacled caiman (6.32 caiman/km) and 3 American crocodiles (0.01 crocodiles/km). Highest encounter rates for caiman were in secondary rivers entering lake Nicaragua and Rio San Juan (14.96 caiman/km) and habitat predominantly consists of tasital vegetative communities, reed beds, and broadleaf forest. American crocodiles were only encountered in the mid reach of the Rio San Juan at the limit of the survey route. Little conflict between people and caiman were reported by communities in the area, however communities consistently reported steady illegal harvest of caiman, and to a lesser extent crocodiles, for leather products in artisanal markets in central Nicaragua. Presently there does not appear to be immediate threats to the caiman and crocodile populations in the area. However, increasing illegal setting of gillnets and illegal harvest of caiman warrants population monitoring and conservation action to mitigate future conservation concerns.

Assessment of the Black Caiman (*Melanosuchus niger*) Appendix I CITES status in Guyana

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Abstract

There are four caiman species in Guyana, namely the smooth fronted caiman, the Cuvier dwarf caiman, the spectacle caiman and the infamous black caiman. Caimans are traded internationally as live and skin specimens. The Guyana Wildlife Conservation and Management Commission is the national authority for the management of wildlife in Guyana. Established under the

Wildlife Management and Conservation of Act of 2016, the Commission is mandated to effectively manage wildlife in Guyana and sanction activities to implement species specific management plans that meet the sustainable use goal and to protect species from exploitation. To this end, surveys were designed to assess the population dynamics of species traded in high volume. The caimans represents an important aspect of the international trade of wildlife, therefore plans are in place to ensure the management of these species are appropriate to the volume of trade. The first survey examined the population status of *Melanosuchus niger* (black caimans) in Guyana to determine if the species' CITES status in Guyana should be revised. The criteria used to evaluate this status was based on the guidelines of Resolution Conference 9.24- Criteria for amendment of Appendices I and II. *M. niger* is currently listed in Appendix I. The research was designed around examining the guidelines for the biological criteria of Appendix I species to see if they were applicable to the local population by conducting a population assessment. A hotspot for the distribution of *M. niger* is the North Rupununi Wetlands, which is home to the Macushi tribe of Guyana. Therefore, traditional knowledge was also considered to understand the interaction and usage of the species as from a local perspective. The research found that the species is abundant and is able to conduct its role in the ecosystem, therefore a recommendation of an Appendix II listed was concluded. Conflicts with caimans occurs both in the interior locations and the mainland in areas designated for housing development. This presentation highlights current studies on caimans as well as the future strategies to document population dynamics and improve overall management of the species in Guyana.

Designing, Constructing and Maintaining a Crocodile Sanctuary in St Thomas Jamaica

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Abstract

Jamaica is an island nation with a colorful history. It is a former Spanish colony, as a result of a Christopher Columbus landing in 1494. The British took over in 1655 and ruled until Jamaica's independence in 1962. American crocodiles, *Crocodylus acutus*, have been a presence since the earliest days, even gracing the Jamaican Coat of Arms. They are also a mascot to the Jamaican Defense Force as well as the national cricket team.

Over the years there have been several population studies for the American crocodiles in Jamaica. At this time, however, there is no definitive overall population number. This issue is currently being undertaken by several entities.

One thing that is certain, the crocodile population on the island is in decline due to a number of factors. Jamaica is a tourist destination and resorts take up much of the islands' beautiful sand beaches. This tends to fragment the population, although on calm days crocodiles will move east/west and vice versa via the sea. In addition to the building of numerous resorts, habitat destruction is happening island-wide. Much of the coastal habitat is under pressure by charcoal producers. There is also a recent influx of people that remove crocodiles for food, creating a new source of income for resident Jamaicans.

This is precisely the reason, and need, for the Jamaican Crocodile Sanctuary located in agriculture land in St Thomas along the southeast coast of Jamaica. Several dedicated people, both Jamaican and international, have put their resources, time, energy, expertise and funding into developing designing, constructung, maintaining, and operating this sanctuary.

The sanctuary currently harbors injured, nuisance, confiscated and unwanted crocodiles. It has 17 ponds, with room for several others. An 8-foot fence surrounds the entire facility, with the individual enclosures surrounded by 6-foot fence. The ponds are fed by water from the adjacent canal.

Three crocodile nests have recently been relocated to the facility and are closely guarded by Laurence Henriques. Once they emerge from the eggs, the hatchlings will be head-started and released into appropriate locations where they have a chance for survival.

The facility is off the grid and self-sufficient, solar powered, features wells with treated water and a septic system. It has a room for short- and long-term scientists, students or volunteers.

Thanks to the vision of Byron Wilson, Don Church, Global Wildlife Conservation, Laurence Henriques and Jan Pael, the Jamaican Crocodile Sanctuary is a reality and a much-needed part of future crocodile conservation in Jamaica.

Its design and construction could serve as a template for other countries in need of such a facility.

Assessing the status and potential reintroduction of the critically endangered Cuban crocodile in the Lanier Swamp, Isla de la Juventud, Cuba

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Abstract

The last remaining wild population of the endemic Cuban crocodile is found in the Southwestern region of the Zapata Swamp. A second stronghold of the species occurred in the Lanier Swamp in Isla de la Juventud until 1950s, when the species was extirpated due to hunting for skins. Reintroduction of this species constitutes a key conservation tool for its recovery. In order to aid these efforts, the Lanier Swamp was selected as the most suitable habitat with highest

reintroduction potential. In 1994, six-hundred Cuban crocodiles were released into the Lanier Swamp, but since then no further steps were taken to reintroduce individuals into this swamp. In order to revive conservation efforts of the Cuban crocodile in this critical swamp, our project will focus in the Lanier Swamp with the main research goals: *Update the distribution range and status of C. rhombifer, the invasive C. crocodilus fuscus and C. acutus, Assesses the degree of poaching and Provide recommendations for the management and potential reintroduction of C. rhombifer.* Four localities of the Laneir Swamp will be monitored, using transect-counts. Transects will be set to cover crocodile-suitable habitats across the ecosystem. We will conduct night spot-counts by boat (rowing speed of 1.0–2.5 km/h) in the fourth locality, covering the southern coastline of the swamp. We will use Oruxmap App to record and geo-reference observed crocodiles, and beginning, end, route, and length of each transect. We will then estimate the encounter rate for each species and obtain estimates of population size using the method suggested by Messel in 1981. We will use ArGis to build an updated distribution map of *C. rhombifer* in the Lanier Swamp. We will record any evidence of poaching during our surveys and estimate the poaching rate for each crocodile species. In parallel, we will conduct an anonymous survey to a minimum of 50 community members from the area where hunting took place historically. Surveys will provide additional poaching estimates and, importantly, perception data of local communities towards the issue, which will be critical to design conservation solutions. We will carry out a Population and Habitat Viability Assessment (PHVA) workshop to discuss the results of our work and update information of the previous PHVA workshop conducted in 2000.

Crocodylians as indicator species: implications for Latin America and the Caribbean

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Abstract

Like the proverbial canary in the coalmine, an indicator species reflects the status of the environment in which it lives. Patterns in a species' presence, abundance, growth, reproduction, or body condition, for example, can be monitored for short- to long-term trends, serving as a proxy for ecosystem health. These can include parameters such as habitat quality, vegetation, prey availability, climate, or presence of environmental contaminants. Because it is not possible to monitor everything in an ecosystem, relying on selected species to serve as ecological indicators can optimize information for decision makers. As such, one important consideration when choosing an indicator species is its ability to be monitored with relative ease.

Crocodylians have the potential to serve as indicator species because several of their population parameters, such as relative density and body condition, reflect hydrologic conditions. They also have a high fecundity and long lifespan, making them candidates for mark-recapture studies. Crocodylians are large predators broadly distributed in a variety of wetland and estuarine ecosystems in the tropics and subtropics. Wetland and coastal areas that comprise their habitat represent some of the most highly imperiled ecosystems globally, and are also some of the most economically valuable. Latin America and the Caribbean boasts the highest biological diversity in the world and has high levels of endemism. Slightly fewer than half of the currently described crocodylian species are found in the region. It also contains approximately one-third of the world's available freshwater resources and one-fifth of mangrove habitat. These habitats provide flood control, reduce erosion, absorb excess nutrients and contaminants, and sustain species of commercial significance. However, nearly two-thirds of the human population is concentrated along the coast, and the region's coastal wetland and estuarine habitat is at risk of degradation, fragmentation, and development. With sufficient data, crocodylian populations in the region could serve as valuable ecological indicators. For example, the American crocodile (*Crocodylus acutus*) is distributed throughout Latin America and the Caribbean, as well as southern Florida, where it is found in subtropical habitats. In the Florida Everglades, it is an important indicator of ecosystem health. Research has linked distribution and abundance of crocodiles in coastal habitats to timing, amount, and location of freshwater flow, and crocodiles exhibit an immediate response to changes in freshwater input. We discuss how restoration success or failure can be evaluated by comparing recent trends of crocodile populations with historical population data and model predictions.

The Sustainable Use of Crocodilians as Tools for Conservation

“Our role as part of the problem and the solution”

Pablo A. Siroski^{1,2,3}

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Abstract

Wildlife is part of human life since the beginning of the times, providing most of the available food until some production systems were developed. Likewise, a generalized conception exists about that hunting and indiscriminate use are considered the main factors responsible for the marked decrease in the populations of wild species throughout the world, but it is a fact that their effects are often of less importance in comparison than the growing loss of habitats caused by the advance of the agricultural frontier expansion, the modification of water courses, deforestation, pollution, the introduction of exotic species, climate change and, the most importantly, the

increase of human population, that which is paradoxically, is actually, the cause of all the previous ones. In the same sense, the constant increase of human populations is intimately related to poverty, which has been historically is considered also as a problem also for the environment. Given these circumstances, there are different scenarios are presented to manage wildlife through sustainable actions, providing the benefits to for local inhabitants by their incorporating them as active "partners" for their efforts.

Crocodylians are very successful examples of how to achieve conservation through the implementation of sustainable use programs. In the 60's, most of the problems were solved by killing crocodylians and nobody concern about the sustainability of these species. After that, there were many attempts of total protection with little success, until the appearance of the incentives for conservation through sustainable use. This allowed the recovery of many populations, and even favored the tolerance of conflicting species. The types of conventional consumptive management applied to crocodylians are: hunting, captive breeding and ranching; each one with particular characteristics and applicable to some or other species. One of the most important limitations of these types of management is that they only apply to species with economic value, which generates a permanent concern for species that do not have it.

The sustainable use of natural resources has been considered the core of conservation and there are many examples that can support this statement. But currently, there are certain protectionist movements potentially going to put at risk the development of some programs through messages and actions of activists far from the reality and the resource, and hidden behind the misapplied definitions and concepts on the rights of animals and their wellness.

In conclusion, the potential disappearance of successful sustainable use programs that have recovered and stabilized numerous populations will have inevitable consequences through the continuous loss of biodiversity. All this is caused by the ignorance and extremism, which put in danger all that which science has proven about the sustainable conservation of wildlife.

Conservation status of the *Caiman crocodilus fuscus* in the Bayano River Basin, Republic of Panama

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Abstract

Two of the 23 species described in the order Crocodylia occur in Panama, the American Crocodile (*Crocodylus accutus*) and the Spectacled Caiman or Babilla (*Caiman crocodilus fuscus*). Crocodilians are top predators of great importance because they promote and maintain the productivity and stability of ecosystems. To establish the ecological benefit of these top predators we must start from the knowledge of their population status and the state of their habitat. In this presentation we will show a preliminary analysis of the state of the Spectacled Caiman population in five sites of the Bayano River watershed, Province of Panama, Panama. The Majé Cordillera River is a tributary of the Bayano River watershed, located in the district of Chepo and the Madugandí indigenous region, and is part of the reservoir of Lake Bayano, which supplies the waters to generate part of the electric power that it supplies the Province of Panama, thus becoming an area of social, political and economic relevance of the country. This area was visited in April 2018 and April 2019. Night counts were made using the spotlight technique. In 2018, 11 km were covered in three nights; a total of 155 individuals were counted (Neonates = 43, Pre-juvenile = 35, Juvenile = 33, Sub-adults = 12 and Adults = 13, only eyes = 19) and 54 individuals were captured. In 2019, 7.65 km were covered in two nights, a total of 241 individuals were counted (Neonates = 24, Pre-juvenile = 123, Juvenile = 38, Sub-adults = 2 and Adults = 0, only eyes = 54) and 42 were captured. The encounter rate was calculated based on the number of animals captured per kilometer. The meeting rate was 4.9 ind / km (n = 54, 11 km, visited places: 5) in 2018, and 5.5 ind / km (n = 42, 7.65 km, visited place: 1) in 2019.

Conservation Status and Proposal of a Management Plan for the Rancho of Spectacled Caiman (*Caiman crocodilus chiapasius*) In "La Encrucijada" Biosphere Reserve, Chiapas, Mexico

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Abstract

Caiman crocodilus chiapasius is the only species of caiman in Mexico, where it is distributed only on the coast of Chiapas, including La Encrucijada Biosphere Reserve (REBIEN for its acronym in Spanish). Few works have been published on this species in Mexico, however, for this research we obtained degree theses not published in scientific journals, reports of

governmental crocodile monitoring programs in the area, and information was collected on caiman populations in the REBIEN during the last 20 years. In 2016, we conducted population surveys of caimans, and conducted interviews in local communities with the objective of knowing the importance that people give to wetlands and their resources, as well as the traditional use of caimans. Our analyzes indicate that there is a decline in caiman populations in the REBIEN. Through interviews we observed that caimans have great importance as traditional "medicine", which is why it is used by the majority of the inhabitants within the REBIEN, generally in an unsustainable way. We also identify that more than 80% of the people in the communities interviewed are interested in the conservation and use of caimans. Given this situation, a sustainable management plan that allows the use of caimans is recommended, and this resource is properly conserved. Our proposal is the ranching of caiman eggs as an alternative conservation, benefiting the inhabitants of the REBIEN. Using the national experience of the monitoring work and the ranching proposal for Morelet's crocodile (*Crocodylus moreletii*), a management plan was designed describing step by step the methodological and legal procedure, to make a sustainable regional use by applying the System of Conservation Units of Wildlife in Mexico (UMA).

Abundance and population structure of the Morelet's Crocodile (*Crocodylus moreletii*) in the region of Calakmul, Campeche, Mexico

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Abstract

Although our knowledge on the population biology of the Morelet's crocodile (*Crocodylus moreletii*) has been rapidly increasing over the last decades, only rudimentary information is currently available about populations from the Selva Maya. In the region of Calakmul (Campeche, Mexico), *C. moreletii* inhabit semi-temporary and therefore highly dynamic natural ponds (*aguadas*) sustained by rainfall, possibly leading to a spatial population structure which is different from other studied populations. Local and total abundance estimations were performed

by the standard method used in Mexico (Visible Fraction - VF, Sánchez-Herrera et al. 2011) and by using a Zero-Inflated Poisson (ZIP) N-mixture model approach, conducting spotlight surveys in 43 waterbodies across the region twice a year between 2018 and 2019. To investigate size class distribution of crocodile encounters, we used a Chi-Square analysis and tested against the null hypothesis of even distribution of size cohorts. Local abundance estimates through VF and ZIP averaged 6.5 ± 2.2 (zero – 73) and 8.97 ± 1.92 (6.93 ± 1.54 – 43.91 ± 15.67), respectively. Total abundance in the region (based on a hydrological dataset published for this region; García-Gil 2000) was estimated at 9499 individuals (8886 – 10154) using TM and as 12426 individuals (9683 – 15950) using ZIP. The overall size structure was significantly different from the theoretical equal distribution of size classes ($\chi^2 = 31.52$, $df = 3$, $p\text{-value} < 0.001$). Approaches based on N-mixture models seem better suited for Calakmul as they incorporate more information and allow for superior inferences compared to traditionally used techniques. Demographic structure can vary between seasons but generally follows a pyramidal scheme with a common structure of 1-2 adults and an increasing number of smaller size class individuals. Taken together, our findings will be essential for management actions towards the conservation of *C. moreletii* populations in *aguadas*, generally serving as an umbrella species for the biodiversity that occurs in them.

Assessing the health of the Cuban crocodile population at the Zanja del Diez, Zapata Swamp, Cuba

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Abstract

The Cuban crocodile (*Crocodylus rhombifer*) is an IUCN listed critically endangered species. To date, there are no studies assessing the health of its wild population in Zapata. The goal of this study was to use body condition index as an indicator of health for the *C. rhombifer* population in the Zanja del Diez, Zapata Swamp, Cuba. To do so, we applied and compared the Fulton's condition factor (FC) and the body condition (CC) scale used in captive crocodiles at the Zapata Crocodile Farm. This method has been used by our team since 2016. In 2018, we captured 10 individuals, seven females and three males, during a survey of the Zanja del Diez. Morphometric measurements taken included total length (LT), head-vent length (LV), tail length (LC), neck circumference (PCu) and tail circumference (PCo). We calculated the regression slope of the natural log of these five measurements on the natural log of mass and tested (Monte Carlo test) whether it was significantly different from 3. The three body condition categories are: poor condition ($FC < \text{mean} - SD$); good condition ($\text{mean} - SD < FC < \text{mean} + SD$) and excellent condition ($FC > \text{mean} + SD$). The regression ($\ln PCo - \ln PV$) was the only parameter by which

we were unable to calculate the FC for *C. rhombifer* in this study. CC calculations resulted in three individuals in categories indicating good or excellent body condition. When compared with the FC, one individual was found to have poor body condition, two having excellent condition and seven in good condition for the relationships between PV-PCu, PV-LT, PV-LV. The regression between PV-LC showed two individuals in excellent condition and the rest with good condition. There are discrepancies between the studied regressions and methods (FC and CC) to discriminate across each category for each individual. Only four individuals were assigned to the same category for all calculations by FC and both methods (FC and CC). Based on the results of both body condition index calculations, all but one crocodile had good or excellent body condition, which would indicate that this is a healthy population in the Zanja del Diez region of the Zapata Swamp. As body condition is just one parameter of health within a population, further studies are needed to fully assess the health of *C. rhombifer* in the Zapata Swamp.

Population Assessment of the Genus *Crocodylus* in the Zanja del Diez, Zapata Swamp National Park, Cuba

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Abstract

Updated information of the demographic variables of populations in the genus *Crocodylus* living in the Zapata Swamp is essential for the conservation of the free-living Cuban crocodile (*Crocodylus rhombifer*). We assessed the abundance of both *Crocodylus* species (*C. rhombifer* and *C. acutus*) in the Zanja del Diez, Zapata Swamp National Park, Cuba. In 2018, we surveyed 8.8 km area of the channel, divided into four transects: Inicio- Planes, Planes- Mariposa, Mariposa- Furtivos and Chino- Final. Night spot counts were conducted by boat and we used the Oruxmap App to record and geo-reference observed crocodiles, as well as the start, end, route, and length of each transect. The values of rate encountered (ER) and the estimated population size (EP) were calculated for each transect and for the whole study area. We observed 54 individuals, of which 42 (77.7 %) were reliably identified to species level, 34 *C. rhombifer*, seven hybrids and one *C. acutus*. The transects with higher ER (1.3 individuals/km) for *C. rhombifer* were Mariposa- Furtivos and Chino- Final. For individuals only identified to genus level of *Crocodylus* was Chino- Final with 4.4 individuals/km. Average encounter rate of the entire area was 0.9 individuals/km for *C. rhombifer* and of 1.8 individuals/km for individuals only identified to the genus level. The highest score for estimated population size for *C. rhombifer* (39 individuals) was in the Planes- Mariposa transect. The total estimated population for the entire area surveyed was 87 *C. rhombifer* and 126 individuals of the genus *Crocodylus*. The relative abundance scores for *C. rhombifer* calculated in this study are lower than previous

surveys. However, these differences may be attributed to the fact that these studies were carried out in different areas of the swamp.

State of habitat and population ecology of crocodiles and alligators Gulf of Montijo Wetland

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Abstract

The mangrove and gallery forests are declining rapidly in almost all regions of the planet. In Panama, the expansion of the agricultural, tourist, and urban frontier has devastated large areas of forest, which had protected beaches, estuaries, and riverbanks, and which were once the natural habitats of the American crocodile (*Crocodylus acutus*) and the Spectacled Caiman or Babilla (*Caiman crocodilus fuscus*).

In order to determine the impact of the expansion of the agricultural, tourist, and urban frontier in the Province of Veraguas, Panama, on the habitats of the crocodiles and caimans of the wetlands of the Gulf of Montijo, geographic analyses of the main waterways that drain into the Gulf of Montijo, Eastern Tropical Pacific of Panama, and a rapid inventory of the populations of the two species in the area were made. The change in the status of habitats was established using ArcMap 10.6 and the forest cover of 1996, 2000, and 2012 generated by the National Environmental Authority, now the Ministry of Environment of Panama. For the calculation of the potential habitat area for the study species, the level curve at 400 m above seal-level and the coastline was used. Night counts and captures were made in the dry and rainy season of 2018. In 23 nights, 74.43 km were covered, 215 animals were counted, and 36 animals were captured (20 alligators and 16 crocodiles). The sex ratio for caimans was 2: 6 female / male and for crocodiles was 2: 6 female / male. The encounter rate was calculated based on the number of animals captured per kilometer traveled. The encounter rate for *Crocodylus acutus* was 0.21 ind / km (n = 16, Distance traveled = 74.43 km, visited places: 12) and for *Caiman crocodilus fuscus* the encounter rate was 0.27 ind / km (n = 20; traveled = 74.43 km, visited places: 12). The potential area for crocodiles and caimans habitats was 7,847.55 Km². Land use increased from 8,901.57 km² in 1996 to 7,779.99 km² in 2000 and to 7,819.1 km² in 2012. Mangrove forests were reduced from 306.21 km² in 1996 to 306.21 km² in 2012.

Spectacled caiman (*Caiman crocodilus*) removal in southern Florida, USA

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Abstract

Spectacled caiman (*Caiman crocodilus*) are crocodylians ranging from southern Mexico to central South America that reach over two meters in total length. They have become established invaders in southern Florida and Puerto Rico, USA; Isla de la Juventud, Cuba; and Isla San Andres, Colombia. Past removal efforts in the USA and Cuba have failed to extirpate them. Yet the scope and duration of these efforts have varied greatly, and the efficacy of these efforts, as well as their impacts on native fauna, have not been well evaluated.

Spectacled caiman have occurred in southern Florida since the 1960s and established a population in the 1970s, generally paralleling introductions in Puerto Rico and Cuba. As an invasive species with a broad diet, they have the potential to impact biological resources. Caiman may prey upon protected species in southern Florida, such as eastern indigo snakes (*Drymarchon couperi*) and young American crocodiles (*Crocodylus acutus*). They may also compete for food and space with native crocodylians, the American alligator (*Alligator mississippiensis*) and American crocodile. Caiman in Florida and Puerto Rico appear to tolerate highly disturbed and urban habitats, increasing the potential for negative human-crocodylian interactions.

We began opportunistic caiman removal efforts in Florida in 2012, and systematic removal efforts have been ongoing since October 2017. Our project's purpose is to remove spectacled caiman and perform necropsies to: (1) improve removal rates of caiman; (2) determine seasonal reproductive activity; (3) augment knowledge of caiman diet in Florida; and (4) test the management hypothesis that as caiman are removed encounter rates and occupancy will decrease and native crocodylian encounter rates and occupancy will increase.

From December 2012 to June 2019 we removed 150 caiman. Necropsies of 39 individuals revealed that the caiman reproductive schedule in Florida may be roughly a month earlier than in their native range and overlaps the schedule of American alligators. Diet analysis yielded prey items composed of 24 insects, 18 plants, 15 reptiles, 10 gastropods, eight crustaceans, five fish, three mammals, three gastroliths, two amphibians, and one occurrence of garbage (plastic). We documented ten previously unreported prey species in Florida, seven of which are native. Encounter rates and occupancy analysis results suggested that caiman encounter rates decreased with removals, but native crocodylian encounter rates and occupancy did not increase.

Conservation Benefits from Social Media Marketing

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Abstract

Social media can be used to leverage this worldwide social community to further extend the reach of our conservation projects and issues. This is a resource and a tool to reach people we would not otherwise be able to physically meet. An obstacle to overcome is the stigma that social media is often viewed as a place for pointless conversations, many photos of the social media user, and a place to say what is on their mind without considerations first. I will discuss some marketing data to provide insight into what is current and what is performing well, and offer results of marketing experiments the Crocodilian Advisory Group conducted on our social media audience.

The overall goal for conservation is to change community behaviors or obtain funding for our projects. Awareness is the term we use to bring knowledge or perception of a particular issue, and education being the process of increasing this awareness or to bring about an enlightening experience. These social media platforms are increasingly becoming an important tool for everyone to use: to increase awareness of their research, conservation projects, and for educating the worldwide community on issues. Currently, there are over 2 billion users on Facebook and over 1 billion users on Instagram; both being the most popular social media platforms. There are a few simple and effective measures to improve your own social media profiles to better utilize the current algorithms. The objective is to increase the visibility of your conservation projects, issues, and research in front of these billions of users. This can then lead to increases in donations and funding for your research, or behavioral changes in the public for the benefit of the animals and their habitats.

While many of us are biologists, we also want to be marketers for these conservation actions. We want to promote the species we are trying to conserve, and to create value for these animals and their habitats to the local communities of people, as well as to the worldwide community. We want to leverage the concept of being a social society and the technology of social media platforms to promote our conservation projects and issues.

June 28, 2019 – Scientific Investigations

Keynote Speaker – Hesiquio Benitez

Use of visual and olfactory stimuli in prey selection by hatchlings Morelet's crocodile (*Crocodylus moreletii*)

Mariana González-Solórzano¹, Marco A. López-Luna^{1,2}, Laura T. Hernández-Salazar¹, Edgar A. Bello-Sánchez¹, and Jorge E. Morales-Mávila¹

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Abstract

Foraging behavior is fundamental for the individual survival involving abilities such as searching, selecting, and using food resources. The sensory modality used prey detection and selection depends on the capacity of the sensory systems of each species. Crocodiles are considered generalist and opportunistic predators, but there is a lack of studies about the chemosensory and visual system involved in prey selection. The aim of this study was to determine which sensory modality (visual or olfactory) favors the prey selection in hatchlings Morelet's crocodile (*Crocodylus moreletii*). We captured 32 hatchlings Morelet's crocodile in the lagoon "Las Ilusiones" in Villahermosa, Tabasco, during February, May, and July 2018. Stomach washings were performed to determine the diet and the preferred prey. Simultaneously with the captures, trapping systems for insects (aquatic and terrestrial) were placed to identify available prey and determine the potential prey. We used 65 newly hatched hatchlings Morelet's crocodile for the experiments, which were carried out in an experimental glass terrarium. We used plasticine models and essence of the preferential and potential prey to test the visual and chemosensory stimuli. We evaluated the latency of detection and the permanence time on each stimulus. The analyses showed that members of the order Coleoptera were the preferential prey while Orthoptera correspond to the potential prey. The prey identified as preferential in the diet did not correspond with the most abundant prey available in the environment. We suggest that hatchlings Morelet's crocodile have food preference. Regarding the sensory experiments, the results did not show differences in the use of the visual or olfactory sense during prey selection.

We discussed the implication of other senses or their combination as advantageous for the hatchlings Morelet's crocodile during foraging behavior.

Estimation of Predation Rate in Hatchlings of Morelet's Crocodile (*Crocodylus moreletii*) Using Clay Models

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Abstract

Predation is an ecological interaction where one individual attack another leading to death, and the main objective is feeding. The clue detection by predators to obtain their food depends on the prey species and environment, due to the predator needs an efficient perception of its surroundings. In crocodilians, yearlings and in some cases even juveniles, are the ontogenically stages with highest predation, therefore is one of the main factors that influence the survival rate of organisms. Different predators of crocodile eggs and hatchlings have been reported, including reptiles, birds and mammals. These predators can use visual, olfactory or auditory stimuli to detect their prey. The objective of this study was to determine if the visual clues or the olfactory clues are used by predators to detect the Morelet's crocodile hatchlings. The study was carried out in the Laguna de las Ilusiones Ecological Reserve located within the city of Villahermosa, Tabasco, Mexico. To evaluate the rates of predation and the type of clues used by predators, non-toxic clay models were used to perform experiments in two ways: 1) Predation by visual detection; the models had size, shape and coloration similar to a Morelet's crocodile hatchling; 2) Predation by olfactory detection, was evaluated with models of size and color similar to the hatchlings, but with a cylindrical shape impregnated with an odorous mixture of fecal matter from crocodile hatchlings. The clay models were placed on the surface of the water near the shore, and on the ground near the water, trap cameras were placed for each surface. A total of 2,304 clay models were distributed in two sites of the lagoon, each site with two environments (surface water-ground), each environment with two clues (Odor-Visual), and each clue with four groups of three clay models. They were monitored during three continuous days in the months of May, June, August and September of 2018. A predator determination was made with the printed marks on the models compare it with the pictures from the trap cam. Seven species of

predators were recorded *Nycticorax nycticorax*, *Ardea alba*, *Ardea herodias*, *Rupornis magnirostris*, *Canis lupus familiaris* y *Didelphis marsupialis*. Predation rate of clay models was 12% for visual experiments and 14% for odor experiments. No significant differences in the rate of predation of both experiments. However, analysis of predation environments did show significant differences, with greater predation on ground than in water, both in visual and odor experiments.

American Crocodile *Crocodylus acutus* Growth at Sumidero Canyon National Park, Chiapas, Mexico

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Abstract

The Sumidero Canyon National Park (SCNP) was decreed in 1980 to protect biodiversity of the area after the construction of the hydro electrical dam in Chicoasén. In 1993, Miguel Alvarez del Toro Zoo (ZooMAT) staff started a conservation project to preserve the endangered American crocodile in SCNP. Activities such as a) nocturnal census, b) nest detection, c) capture – mark – recapture, d) collection of wild eggs and e) raising neonates at ZooMAT for 1 – 2 years, f) release of crocodiles collected from the SCNP and g) those hatched from the pair at ZooMAT, were performed until 2003. Growth data analysis was based on four groups of young crocodiles: 1) Wild caught – marked – released (CAMARE), 2) Wild Caught and Raised at ZooMAT (WCRZ), 3) Wild Egg Incubated at ZooMAT (WEIZ), 4) Hatchlings obtained from the ZooMAT pair (ZooH). All crocodiles were marked by removing scales from the tail crests giving each individual a unique number that could be observed from a distance when basking. The size estimations were done using photographs taken by the tourists visiting the SCNP who randomly posted them on the internet. 65 different American crocodiles were identified showing clear identifiable marks on their tails. Total length and sex were estimated by the author's expertise and with another expert on American alligators. Survival was 29.3% for crocs released at 2 years sother American croc populations 1♂:1.5♀, but photographed crocodiles obtained from eggs incubated at ZooMAT (WEIZ and ZooH) had a sex ratio 1♂:1♀. Age of females at 1st nesting was 9 years and the growth curve started slowing down around that time. Both sexes had steady 50 cm/year growth that slowed down when females reached 7 and males 9 years old. After that, females averaged a growth of 10 and males 20 cm/year. Females stopped growing when they reached 13 years but males kept adding length after age 16 when their curve starts to get asymptotic. Males grow longer than females; the highest total length in this study was a 4.6 m. male and the longest female was estimated to be 3.5 m. Previously, it was commonly thought that American crocodiles over 4 m. were individuals over 50 years. Today it is clear that a 20 year old male American crocodile can easily measure 4 m. in total length.

Case Study: Behavioral techniques applied to Wild Crocodiles and recent captured Crocodiles for rerelease in *C. acutus*

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Abstract

Problematic American Crocodiles with the potential of human Crocodile conflict on Ambergris Caye, Belize were subjected to several stimuli to encourage avoidance and capture. Several training sessions were applied with positive results. Techniques were capture with intention of release before submission, cueing animals with no reinforcements, continued cueing of animals with catch equipment in visual range. Prescribed training to an American Crocodile recently captured and scheduled to be released was applied for avoidance and capture. Outcome is still unknown.

Scale patterns of the American and the Morelet's crocodile in Southeastern Mexico

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Abstract

American crocodile (*Crocodylus acutus*) and Morelet's crocodile (*Crocodylus moreletii*) are the two crocodilian species that can be found in Southeastern Mexico. Even though the similarity between these species, morphological differences occur among scale patterns. Moreover, due to the sympatry of these species, hybridization phenomena have been observed in the Usumacinta river basin. Besides, with the isolation, genetically "pure" *C. acutus* populations of Banco Chinchorro biosphere reserve and Cozumel Island could be in the process of speciation. The scutellation of these three populations have been sampled from 2001 to 2019 focusing on different scale cluster: post-occipital; nuchal; dorsal; single and double crested caudal whorls; ventral scale rows (left and right) and the fusiform scales (left, right and lower part of the tail).

Mean comparison tests are then used to compare collected data. By comparing the scales patterns of *C. acutus* and *C. moreletii* significant differences appear among several scales patterns. These species thus have specific scale patterns, and these scale clusters could then be used to difference the two species and also use to inquire the hybridization between them in the Usumacinta basin population. The two *C. acutus* populations also show significant difference between their scale patterns, supporting the supposition that these population could be in a speciation process. Furthermore, focusing on the scutellation of hatchlings, the results show that a great diversity of patterns also occurs among siblings. By now comparing the scales patterns of *C. moreletii* of the lower and the medium part of the Usumacinta basin, several significant differences are highlighted and the results tend to show that the scute patterns of the lower basin population are closer to the patterns of *C. acutus* than the population of the medium basin. These results tend to confirm that the hybridization rate is more important in the lower part of the river basin and the presence of an hybridization gradient along the river. Further genetic analysis are needed to confirm all these morphological analysis.

Keeping Track: Satellite transmitter deployment on crocodiles in Belize

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Abstract

The success of conservation and management programs depends on contemporary and reliable scientific data that can be translated into local and national policy (i.e, translational ecology). One way that scientists are increasingly able to provide such data is through the use of satellite tracking technologies. Satellite transmitters are valuable resources for tracking wildlife, particularly cryptic species, such as crocodiles. Belize was once a stronghold for American crocodiles, however, half a century of exploitation decimated populations until the species became nationally protected under Wildlife Protection Act of 1981. Although past threats have diminished, increasing development of critical crocodile habitat is resulting in displacement of crocodiles and mounting human-crocodile conflict. In order to begin assessing how crocodiles utilize habitat in Belize, the Crocodile Research Coalition deployed the first satellite transmitter on an adult American crocodile in Central America. We used a Telonics Iridium SeaTrkr satellite transmitter (190 grams; 10.3 cm in length), to transmit location fixes daily on a 6-hour transmission schedule. Our objective is to utilize the deployment of satellite transmitters to investigate the spatial ecology of crocodiles in Belize and utilize robust spatial data to advise the creation of protected areas for crocodile conservation, determine the efficacy of crocodile relocation as a management tool, and create tools to better mitigate human-crocodile conflict through better comprehension of crocodile movement and habitat use

Crocodile claws as a potential non-invasive biomarker of metal exposure

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Abstract

Although crocodylian caudal scutes have been identified as ideal indicators of metal accumulation and blood fractions are useful to determine the response of heavy metal binding proteins to heavy metal exposure, the amount of tissue and blood required for such analyses is considerably high and remains invasive. Layers of keratin in tissues like skin and claws tend to compartmentalize metals. Nevertheless, it remains uncertain if the claws may be a better indicator for toxic metal exposure, rather than skin or caudal scutes with the additional advantage of representing a non-invasive method to monitor the health of wild organisms. In this study we analyzed two physiological (Cu and Zn) and two xenobiotic (Cd and Hg) metals in skin and claws from paws of captive Morelet's crocodiles (*Crocodylus moreletii*) from a Wildlife Management Unit (WMU) and compared them with concentrations of caudal scutes and claws from a wild population from Chichankanab Lake, in order to assess the potential of crocodile claws as an indicator of metal exposure. Concentrations in claws were the highest of all tissues analyzed; significant differences of Cd, Cu, and Zn in claws were observed between sites ($p < 0.05$). Also, when comparing the three tissue types, significant differences of metals concentrations were observed. The post-hoc test revealed that Hg and Cd in claws and scutes are not different, although both metals were different from the concentration in skin. As for Cu and Zn, the concentrations in claws were completely different from scutes and skin. Individuals from the WMU are exposed to xenobiotic metals only by ingestion; thus, keratinized tissues act as a detoxification strategy, while in wild individuals, in addition to this strategy, sequestering of metals in epidermal tissues (by dermal absorption) is acting as a protection mechanism of metal exposure in the environment. Our results demonstrate claws are an excellent tool for assessing metal exposure and their collection is less complicated than other tissues. We strongly recommend their implementation in studies of metal exposure.

Concentrations of pollutants in sediment and in tissue of crocodiles (*Crocodylus moreletii*) of the Usumacinta river basin, Mexico

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Abstract

The Usumacinta river basin (URB) is the most biodiverse region of Mexico and Guatemala and one of the most important biodiverse areas in the world. Sediment is a critical component of the aquatic ecosystems of the URB, as it carries nutrients and a series of organic substances, including pollutants, which enter the food chain and can threaten the health of live organisms and biological communities by bioaccumulation and biomagnification. The objective of this study was to determine the concentrations of heavy metals (HMs), Persistent Organic Pollutants (POPs) and Polycyclic Aromatic Hydrocarbon (PAHs) in sediment (basal component) and crocodiles tissue (top predator) of the Mexican side of the URB, and to see if they threaten the ecosystem and human health. We collected 24 samples of sediment and caudal scales of 19 Morelet's crocodiles (*Crocodylus moreletii*) from six sites of the URB. We analyzed the samples for 11 HMs, 20 POPs and 16 PAHs. Of the 47 compounds analyzed, 39 (11 HMs, 17 POPs and 11 PAHs) were detected in sediment and 25 (11 HMs, 8 POPs y 6 PAHs) were found in scales of crocodiles. Of the HMs, concentrations of cadmium and mercury exceed the thresholds quality values recommended for sediment according to international standards. Concentrations of cadmium, mercury and lead in crocodile scales also exceed maximum levels recommended for human consumption according Mexican and international standards. Of the detected POPs, DDT, lindan, endrin, dieldrin and chlordane exceed some maximum values internationally recommended. The PAHs detected in sediment and scales of crocodiles of the URB are mainly of pyrogenic origin and none of the concentrations exceed recommended or authorized maximum values according international standards. We did not find regulations on the presence of those compounds in food. More specific analyses on some substances are necessary to study their possible effects on environmental and human health.

Crocodile Conservation Program of the Municipality of Puerto Vallarta, Jalisco

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Abstract

In the municipality of Puerto Vallarta, Jalisco, the development of tourism infrastructure and public services has generated competition for the use of spaces between humans and crocodiles caused by the loss of habitat, which has caused crocodiles to be displaced from the spaces that historically belonged to them. Due to this situation, the Crocodile Conservation Program of the Municipality of Puerto Vallarta, Jalisco is created, with the protection and conservation of the crocodile being a priority in the program. The actions undertaken are focused on: 1) Placing informative and restrictive signs in areas where crocodile is present; 2) Surveillance tours in areas of greater affluence of the species; 3) Response to reports about crocodile presence; 4) Rehabilitation of sick or injured individuals; 5) Workshops on environmental education to sensitize the public and reduce accidents caused by the imprudence of humans; 6) Management and proposal of crocodile protection areas. The protection and conservation of crocodile's habitat and associated species, as well as refuge and feeding areas, bring about a significant improvement in environmental quality, which directly provides benefits for inhabitants and visitors of the municipality.

Factors Affecting Morelet's Crocodile (*Crocodylus moreletti*) Body Condition in Belize: Do Multiple Recaptures Result in Skinnier Crocodiles?

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Abstract

Ecotourism – tourism that is centered around natural environments and is educational, ethical, and sustainable – provides an increasing economic benefit to Latin America and the Caribbean. The region is a hotspot for both biodiversity and tourism. This economic benefit can encourage stakeholders to lead conservation efforts. Additionally, tourists who view or interact with wild animals may gain a more positive attitude towards the animals, see a higher potential for

coexistence, and perceive the animals as lower risk. This can translate to public support for conservation action. However, encounters involving the capture of wildlife can be stressful and can lead to a long-term decline in their health and breeding success. Crocodylians are charismatic megafauna that have the potential to provide opportunities for ecotourism in Latin America and the Caribbean. The capture of crocodylians induces stress and increases wariness, but long-term impacts of repeat captures on crocodylian health requires further examination.

Using data from Morelet's crocodiles (*Crocodylus moreletii*) captured in New River Lagoon, Belize, from July 1996 to January 2019, we analyzed the impact of repeat captures on their body condition. From 1996 to 2004, crocodiles were captured by researchers from the Wildlife Conservation Society and Texas Tech University as part of a study on the ecology of Morelet's crocodiles in northern Belize. From 2004 to the present, crocodiles were captured as part of an ecotourism-based long-term monitoring program conducted in collaboration with the Lamanai Field Research Center. Researchers followed established protocols for handling crocodiles and collected data on snout-vent length (SVL), total length, mass, and sex. Researchers marked individuals by notching a unique series of caudal scutes or, starting in 2004, by implanting passive integrated transponder (PIT) tags.

Researchers captured 860 individuals across 1301 capture events, with 623 individuals captured only once, and 237 individuals captured multiple times. Using SVL and mass of non-hatchling individuals ($SVL \geq 15$ cm), we calculated Fulton's Condition Factor as a measure of body condition. We used a mixed-model repeated measures analysis to examine trends across repeat captures, and included time between captures, year, temperature, water level, and size class as covariates. We did not recover a negative trend in Morelet's crocodile body condition with an increase in repeat captures, but we found a positive effect of age-class on body condition. If ecotourism agencies follow strict protocol with crocodile health in mind, the benefits of tourism on conservation will exceed the impact of tourism on crocodile health.

Chronology of heavy metals in sediments and determination of the concentration of these metals in sediment and scutes of *Crocodylus acutus* in marine-coastal environments of the Gulf of Chiriquí and Montijo

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Abstract

Heavy metals have the capacity to persist over time, to bioaccumulate and biomagnify. Therefore, it is important to establish a direct connection of these disruptive contaminants with the marine coastal environment. This connection can be established using the American Crocodile (*Crocodylus acutus*), as a bioindicator. Because of the tendency of heavy metals to accumulate through the trophic chain, apex predators such as the American crocodile should reflect the bioaccumulation of heavy metals such as Chromium (Cr), Cadmium (Cd), Copper (Cu), Lead (Pb), Arsenic (As), Selenium (Se), Antimony (Sb), Vanadium (V), Stannum (Sn), and Strontium (Sr). We used the American crocodile as a bioindicator and determine the differences between heavy metals concentrations among crocodiles captured on Coiba Island, Panama, when compared to crocodiles captured from the mainland in Montijo Bay. Spotlight survey transects were undertaken by foot on Coiba Island and by boat in the Montijo bay (Chabrek, 1966) for over a 2 year period; a total of 141 individuals were captured and classified by group size (Neonates < 36 cm juvenile 30 – 90 cm, sub-adult 91 – 180 cm, and adult > 180 cm; per Platt and Thorbjarnarson 2000). Only 101 reached the weight necessary to continue the analysis. Crocodiles were marked by tail scute clipping. The samples obtained from crocodile scutes were analyzed using inductively coupled plasma mass spectrometry (ICP-MS) to determine the concentrations of heavy metals in the two study areas chosen (Coiba Island and Montijo Bay). Strontium (Sr), Copper (Cu), Stannum (Sn), Chromium (Cr) and Vanadium (V) were the metals that show higher concentration in the samples. A significance difference between sexes was not found.

Sedimentary core samples were taken to reconstruct the recent geochronology (100 years) of the two study areas located in Panama, which will allow us to understand the bioaccumulation history of the study sites and compare these concentrations to the American crocodile samples. With this link established, we can recognize any possible anthropogenic activities in the area and their impact on the marine environment. This project generates a clear conservation strategy for the population of crocodiles located from Coiba Island, and the Gulf of Montijo Gulf in Panama, and ultimately contributes to the development of future strategies for fisheries and other activities that affect the marine coastal environment.

Origin and evolutionary history of Banco Chinchorro saltwater crocodiles

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Abstract

Banco Chinchorro UNESCO Biosphere reserve is an atoll located 30 km from the coast of Yucatan, containing many species of reptiles protected by CITES, IUCN and the Mexican government. One of them is *Crocodylus acutus*, which is widely distributed in Pacific, Atlantic and Caribbean coasts and islands. The ecology, morphology, and behaviour of the Banco Chinchorro *Crocodylus* population has been studied for the past two decades and results suggest it is an isolated population with potential molecular and morphological differentiation. Recent genetic population studies also suggest that it is a pure *C. acutus* population. Our study goals were to use next-generation sequencing to determine: 1) Is there population structure within the population? 2) Are Banco Chinchorro crocodiles a pure population? 3) What is the origin and regional biogeography of Banco Chinchorro crocodiles? We collected 218 scale samples from 15 localities and two species of crocodiles (*C. acutus* and *C. moreletii*) in Mexico and Panama. We used Single Digest Restriction site Associated DNA Sequencing (sRAD-Seq) to genotype all the samples. We filtered, cleaned and mapped the sequences to the reference genome of *C. porosus*. We retrieved 15 thousand SNP's with more than 10 thousand SNP's per population. The heterozygosity observed in Banco Chinchorro is lower ($H_o=0.15$) than expected, suggesting relative isolation of the population from coastal populations. With an all-pairs population comparison, the Banco Chinchorro population differentiation is the lowest ($F_{ST}=0.16$). The population's structure inference shows the presence of two genetic clusters in Banco Chinchorro, which is also supported by principal component analysis (PCA) and discriminant analysis of principal components (DAPC). Demographic models show that the Banco Chinchorro population diverged from Caribbean *C. acutus* populations approximately 1500 generations ago, as well as contemporary gene flow from the atoll to coastal populations. This population has the lowest degree of differentiation compared to other populations in Mexico and Panama. It further exhibits a deficiency of heterozygotes perhaps caused by inbreeding and isolation. We propose the Yucatan current may be the cause of homogenization of the Banco Chinchorro population with other crocodile populations. We found two discrete lineages with limited gene flow in Banco Chinchorro as shown in previous studies. Our results indicate that Banco Chinchorro crocodiles are isolated, with population subdivision, and are a source of genetic variation to populations in the Yucatan Peninsula Coast and the Gulf of Mexico. We outline special protection efforts for conservation of this unique, marine population.

Tail Amputation in Cuvier's Dwarf Caiman *Paleosuchus palpebrosus*

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Abstract

Many animals have the ability to lose or alter an extremity to avoid a predator attack. This phenomena, known as autotomy, is voluntary and does not necessarily require the predator's contact with the prey limb. Tail injuries in crocodilians are very common in nature and under human care. The tails are commonly found with missing tips; but for the Family Alligatoridae and more in particular within the different species of the genus *Caiman*, *Melanosuchus*, and *Paleosuchus*, the tail shows regeneration with a tissue different from the original. There are reports of tail regeneration in *Caiman* and *Melanosuchus* with an extension of connective tissue that ossifies. Many *Paleosuchus palpebrosus* lose the tip of their tails in El Pantanal and The Flooded Forest in the central Amazon in Brazil. A team in Brazil reported no caimans captured had the tip of their tails. We are presenting four cases of *Caudotomy* in *Paleosuchus palpebrosus* held at the DWA; one is an adult male and the other three cases are yearlings. In all cases the tip of the tail was disarticulated and easily detached after handling or a conspecific fight. Although this is not a novel occurrence, the fragility and ease with which the tips are lost appears to be unique to *P. palpebrosus* in comparison with other crocodilians. It is possible that other closely related species such as *P. trigonatus* may exhibit this trait as well, but to date there have been no such reports. We recommend to not pull or strongly grab the last third of the tail in Dwarf caimans as *Caudotomy* may occur. The tail will regenerate with different tissue, shape, and length. We did not perform histopathology analysis, so we cannot conclude at the present time if the new appendages of *Paleosuchus palpebrosus* will be ossified.

June 27, 2019 – Poster Session

Assessment of heavy metals in water, sediment, and American crocodile (*Crocodylus acutus*) muscle tissue in coastal-marine environments in Coiba National Park and the Gulf of Montijo

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Abstract

The American crocodile (*Crocodylus acutus*) is a bumper and long-lived predator of marine and coastal environments. Heavy metals contributed to the crocodile habitat, natural or anthropically, enter the food chain affecting reproduction, physiology and morphology of the species. Trophic position and longevity of crocodiles may be useful factors for establishing this species as indicator of habitat pollution by heavy metals. In Panama there is a need to determine and monitor habitats pollutants; so, the Coiba National Park (PNC) and the Gulf of Montijo (GM) are optimal areas to perform chronological characterization of the concentration of heavy metals and their transfer through trophic levels. The concentration of As, Cr, Cu, Pb and Cd in saline water, sediments and American crocodile muscle tissue were determined by spectrophotometry. Concentration on water and sediments are high, at the level of contamination. We evaluated temporal trends and complex interactions between heavy metals and the ecosystems. We performed a chronological study of sedimentary cores in the area with the technique of the ²¹⁰Pb. The sedimentary distribution was complemented with a study of currents in the NCP and the GM. Measurements of water density and salinity allowed us to model the pattern of water interchange in the area. Here in, we present preliminary results.

Giant Crocodiles of Jalisco's Coast Line

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Abstract

Jalisco's coastline is found within the tropical zone of México, it's featured by an accurate environment for *Crocodylus acutus*, since there are wetlands, rivers coastal lagoons and dams. Geographically is limited in the north border by Ameca river in Puerto Vallarta municipality, and in the south by Marabasco river in Cihuatlán municipality.

The higher amount of crocodile's captures have been taken place in two locations, Puerto Vallarta, a small city with infrastructure and grand tourism development, with a population of people of over 275 000, and where the interaction and conflicts human-crocodile happens very often; and at La Manzanilla, a small village with a population of people about 1500, where people live from fishing, agriculture, and ecotourism, and has been recognized as an area of crocodile protection by the community. Following data collected from 2011 to 2018, the result of crocodile's captures during the population's investigation, as well as the captures that were necessary to give a social solution to the conflict between humans and crocodiles. In Puerto Vallarta, crocodiles are mainly distributed in two areas, Boca Negra–Boca de Tomates estuaries, with about 220 hectares, and El Salado estuary with about 169 hectares, both places are surrounded by the city and the touristic development; in this municipality 13 giant crocodiles have been captured, their measures were between 3.4 and 4 m, and skull length between 50.4 and 59 cm. In the same period, 14 crocodiles between 2 and 3.5 m were dead by humans.

In La Manzanilla estuary, with about 200 hectares, 12 crocodiles were captured, their measures were between 3.50 y 4.77m, and the skull length between 53 and 65 cm, so far, the biggest crocodiles in the west of México. The Isometry of both populations indicates that if total length increases, skull length will increase too, and that measures are related for Puerto Vallarta with $R^2=0.83$ and La Manzanilla $R^2=0.91$, (figures 1 & 2). Finally, we can observe that crocodiles' lengths in the most disturbed population barely get 4 m, while in the protected population crocodiles can reach even 4.77m, this confirms the potential of the species to get sizes over 5 m if it has available their biological requirements. It's important to know the record of giant crocodiles, it's a demonstration of species success to the constant changes of its habitat by the human activities, and this also indicates the environmental health of the ecosystem.

Latitudinal Variation of Persistent Organic Pollutant (POPs) Concentrations in Caudal Scutes of Morelet's Crocodiles (*Crocodylus moreletii*) in Mexico

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Abstract

Persistent organic pollutants (POPs) are substances with high half-life that bioaccumulate and are transported across large distances with potential long-term adverse effects on human health and the environment. The aim of this study was to evaluate latitudinal distribution of accumulated concentrations of POPs in the caudal scutes of Morelet's crocodiles (*Crocodylus moreletii*) in Mexico. Spotlight surveys and crocodile captures were conducted between 2014 and 2015 in 16 areas that represent most of the distribution range of *C. moreletii* within Mexico. Each captured crocodile was measured (total length and snout-vent length - SVL), weighted and marked by removal of a unique combination of three caudal scutes. The extraction of contaminants from caudal scutes was done using a microwave oven (MarsXpress 5, CEM) set to 110 °C and clean up with n-hexane and dichloromethane in chromatographic columns with Florisil and sodium sulfate. The quantification of POPs was done through gas chromatography with an electron capture detector (Varian 3800). A generalized linear model (GLM) was used to evaluate the relationship among number of detected POPs in each crocodile and capture location (latitude) and body size (SVL). Measures of central tendency and dispersion were estimated for SDDTs and SPCBs using "regression on order statistics" (ROS) for censored data. Relationship between capture latitude and concentrations of POPs in caudal scutes was tested using non-parametric Kendall correlations with Akritas–Theil–Sen regression estimator between SDDTs and SPCBs and crocodile capture latitude and SVL. We detected at least one compound in all captured crocodiles (43 crocodiles). Number of pollutants was positively associated to the latitude ($p < 0.001$) and crocodile SVL ($p < 0.001$), and the relationships were described by the following equation: $\sqrt{\text{POPs}} = -7.136 + (0.377 * \text{Latitude}) + (0.002 * \text{SVL})$. Quantifiable concentrations of SDDTs and SPCBs were detected in 30% ($n = 13$) and 35% ($n = 15$) of tested crocodile scutes, respectively. Detected concentrations of both SDDTs and SPCBs were significantly affected by latitude ($t = 0.19$ and $t = 0.22$, respectively) and SVL ($t = 0.32$ and $t = 0.20$ respectively). This study is the first to evaluate the geographic distribution of bioaccumulation of POPs in wild reptiles and the respective implications in its latitudinal transportation. Further monitoring effort should be carried focusing on the local and regional distribution of these and other contaminants, evaluating the possible long-term effects to conservation on a population level.

Ecology & Ecotoxicology of French Guianese Caimans

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Abstract

Anthropogenic activities such as gold-mining lead to a major contamination of the aquatic habitats, especially by the release of environmental mercury (Hg) stored into the soil and exogenous mercury used for gold extraction. In French Guiana, both legal and illegal mining activities increase the mercury levels and possibly other pollutants like heavy metals, in an area where the natural Hg levels are already high. This pollution leads to major issues locally, both at the biodiversity and public health level: nature is threatened, and furthermore, human settlements that rely on a rather traditional livelihood, along the river banks, are also strongly impacted through the food chain, with direct health impacts.

The choice of caimans as a proxy for such environmental studies is based on their natural history, as they are sedentary predators ranked at the top level of the food chain, perfectly integrating the successive pollutant doses bioaccumulated into the underlying levels of the trophic web. Moreover, by foraging both on terrestrial and aquatic habitats, they are good bioindicators for global area assessments. Also, as long-lived ectothermic vertebrates, with a relatively low metabolism and energy conversion rate, they represent first choice bioindicators for long-term pollution assessments. Thus, they constitute a good proxy to understand the global characteristics of the environment in which they thrive.

This project aims to produce a significant volume of data on the four species of French Guianese caimans (*Caiman crocodilus*, *Melanosuchus niger*, *Paleosuchus palpebrosus* and *P. trigonatus*) throughout the country, both on ecology and ecotoxicology. Crocodilians represent a poorly studied zoological group in French Guiana, in comparison with the extensive studies available about other taxa. In particular, few data are available concerning the genus *Paleosuchus* at the local level; especially, the locally abundant and well distributed *Paleosuchus trigonatus* could be a good proxy for environmental studies, regarding pollution assessment through the food chains, effects of anthropogenic pressure on the forested ecosystems (97% of the territory) and global warming. Moreover, we aim to characterize the levels of contamination of the French Guianese environment by trace elements, in relation to anthropogenic activities (gold mining, industries,

urbanization), and to better understand the physiological and ecological effects these anthropogenic activities can generate on the caimans, in order to set up management proposals, consolidating a more sustainable development of the locally fast growing human population.

Hematology and blood biochemistry of Amazonian caiman species (*Caiman crocodilus*, *Melanosuchus niger*, *Paleosuchus trigonatus* and *Paleosuchus palpebrosus*) in urban and wild areas in Central Amazonia, Brazil

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Abstract

Crocodylian hematology and serum/plasma biochemical values exhibit wide variation between and within species. These differences may be attributed to habitat, nutrition, sex, age, population dynamics, and many other environmental conditions. Reference ranges for physiological parameters have been reported for many reptiles, including several crocodylian species. Yet blood and plasma biochemistry information is still limited to non-existent for wild or urban crocodylians in Central Amazonia, where individuals are exposed to highly dynamic abiotic and biotic stressors. We collected blood samples from 90 urban, captive and wild caimans of all four Amazonian species (*Caiman crocodilus*, *Melanosuchus niger*, *Paleosuchus trigonatus* and *Paleosuchus palpebrosus*) over a 2-yr period to establish reference intervals for six blood (red blood cells, hematocrit, hemoglobin, MCV, MCH and MCHC) and four plasma (glucose, triglycerides, cholesterol and total proteins) parameters. Blood samples were collected from the supravertebral sinus into a sterile syringe using the appropriate needle size according to caiman size class, immediately after capture and physical immobilization procedures and before the measuring and weighting procedures. Although minor differences were observed in hematologic and blood biochemistry values between caiman species, overall, all blood parameters were, to some extent, similar to what was previously reported for *C. crocodilus* and *M. niger* in other locations across their distribution range and also to what was reported for other crocodylian species. The hematological and biochemical analysis carried during this study was able to provide valuable information on the internal physiology of urban and wild Amazonian caimans.

The reference intervals provided by our study should provide baseline data for evaluating wild and urban caimans, at least for Central Amazonia.

Knowledge and perception about crocodiles in communities surrounding Catemaco's Lake, Ver. Mexico

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Abstract

Regarding human and wildlife relationships, perception of wildlife has been considered priority in research, since acknowledging species relevance in ecosystems health and its tie to human communities is necessary to implement successful species conservation strategies. Crocodiles are vulnerable to human activities which increasingly overlap with crocodile habitat. They are important in maintaining processes in the ecosystem because of their ecological functions and position in the trophic pyramid and as top predators. However, there is a void of knowledge on perception of crocodiles in general. Crocs have been threatened by hunting, incidental fishing and habitat destruction in places like Catemaco. This study focuses on analyzing the knowledge and opinion of locals in the surrounding area of Catemaco's Lake (Ver., México).

Methodology: A semi-open survey of 13 questions was conducted to residents of five communities surrounding the Catemaco's Lake with a stratified model at 95% confidence. Exploratory analysis where conducted through frequency tables (R-Project, version 3.5.3), profile charts and relative frequencies to compare results between localities. First inferential analysis (Chi2 tests) were also performed for two key knowledge concepts, 1) are crocs important? and 2) are crocs dangerous?

Results: Between 90 and 100% of participants in each community are aware of the presence of crocodiles in the lake, their food and housing sites. 81% of participants believe crocodiles are dangerous. However Coyame and Ojaxapan, communities adjacent to crocs habitat, show a significant difference on opinion. Suggesting that danger perception comes from lack of contact with this group. Perception on danger of crocs seem to be related to the age of participants, since we found significant differences, being the group over 40 years the one that showed less understanding on crocodiles relevance. 68% of respondents recognize that there are threats to crocodiles in Catemaco's Lake. A total of 47% considers crocodiles to be important and this is not related to the contact or nearness to the crocs habitat. A high percentage of participants believe that crocodile populations face certain threats. Tebanca is the most informed community in general terms and stands out from the rest.

Conclusion: A high percentage recognizes the importance of crocodiles in the ecosystem. Most participants perceive crocodiles as a threat to their safety. It is necessary to approach communities to work with their knowledge and perception, especially to recognize the importance of the crocs in their systems and improve a better relationship between humans and crocodiles to boost conservation.

A Note on the Initial Shedding of Teeth in *Crocodylus moreletii*

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Abstract

Several topics within the realm of crocodylian dentition are fairly well known and studied, particularly those which concern tooth development, structure, and function. The polyphyodontic characteristic of crocodylians is fairly well known and studies, such as those conducted by Poole, have estimated the frequency with which teeth are shed and regenerated, at least for adult *C. niloticus*. However, little seems to be written about patterns of tooth growth and shedding for neonatal individuals of any species. After reviewing available literature and conferring with fellow colleagues and hobbyists alike, we have found that information on the matter is lacking and there is a range of speculations about when shedding of teeth first takes place. These have ranged from about 5 months to about 1 year after hatching, per our query. Our study group consisted of 13 hatchling Morelet's Crocodiles (*Crocodylus moreletii*) at the Dallas World Aquarium, Dallas, Texas, United States. At 93 days of age we began finding shed teeth in their enclosure. Of the first seven teeth that were found, the smallest measured 0.87 mm from the tip to the base of the crown and 0.59 mm in width at the base. The largest measured 1.99 mm and 0.88 mm, respectively. This, along with radiographs taken of some individuals and references from monthly cranial photographs from a concurrent study with the same group of individuals, seem to provide solid evidence that the initial shedding of teeth for this species may occur at least as early as about 90 days after hatching. This is much sooner than most of the speculations that we have come across and may be some of the first documentation of evidence of the initial shedding of teeth of this species. Additionally, this may shed some light onto tooth growth patterns and shedding rates for species similar to *C. moreletii*, as well as for other crocodylian species whose ontogeny may differ greatly. For example, at this institution we have also previously observed shedding of teeth occur as early as 60 days in *C. intermedius*, a much larger and faster growing species, suggesting that rates of tooth shedding may be correlated with individual growth rate.

Stage structured population modeling for *Crocodylus moreletii* in Southeast Mexico

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Abstract

Crocodylian populations around the world are threatened by a combination of factors such as habitat loss, over-exploitation and inadequate conservation actions. In the case of Morelet's crocodile (*Crocodylus Moreletii*), its populations are in the process of recovery from depletion by hunting during the second half of 20th century. However, knowledge about the population dynamics of Morelet's crocodile is needed in order to have reliable information that support the conservation actions for this species. Capture-Mark-Recapture methods are frequently used for other species, but only rarely in the study of crocodiles. Using CMR combined with Matrix population models, provides a good understanding of the dynamic of the population (Caswell and Fujiwara 2004). In this study, a structured population analysis was performed for a population of Morelet's crocodile from Southeast Mexico. We used data from Capture-Mark-Recapture survey in Campeche, Mexico to estimate survival and transition survival for each stage or size stage. To estimate the fertilities, we used a set of data from nest monitoring program in Tabasco, Mexico. Parameter estimation for survival was performed using multistrata model in RMark. The results show a population growth rate of 0.91, which is characteristic of a declining population. The report of the stage stable structure indicates that this population has 73 % of individuals in the stage I (<50 cm TL). Elasticity analysis for *C. moreletii* identified that proportional changes in survival of stage IV, followed by the survival and transition survival of the stages II and III, are the most important parameters to the population's intrinsic rate of increase. In the lower level parameters analysis, the survival of the stage II is the one that contribute the most to changes in λ . A simulation of management scenarios were performed, indicating that this population can increase its population growth rate if management actions are focused on increasing the survival and fertility rates of stages III and IV. The latter would help the population to increase its λ from 0.91 to 1.01. The analysis presented here, constitutes one of the first matrix population analysis for *C. moreletii* from CMR data.

Population status of *Crocodylus acutus* and *Crocodylus moreletii* in the Área de Protección de Flora y Fauna Yum Balam, Quintana Roo, Mexico

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Abstract

Crocodiles accomplish specific regulatory functions for the ecological balance. The objective of this study was to determine the population status of *Crocodylus acutus* and *Crocodylus moreletii* based on their distribution, density (encounter rates) and demographic structure (class sizes and sex ratio). The surveys were conducted in the Area de Protección de Flora and Fauna Yum Balam, using an aluminum flat bottom boat equipped with outboard motor (15-25 HP). Our results show that the distribution was mainly aggregated and dispersed. We estimated a total abundance of 114.8 individuals and an encounter rate of 12.89 ind/km, including both species, in a total distance of 8.9 km, corresponding to three water bodies. The demographic structure of *C. acutus* is composed mainly by juveniles (28.39%), followed by yearlings (24.13%), subadults (24.12%) and adults (5.22%); while for *C. moreletii* was represented by adults (22.01%), juveniles (17.36%) and subadults (6.25%). The sex ratio for *C. acutus* had a bias towards females (0.8♂:1.2♀), while for the *C. moreletii* was observed the parity (1♂:1♀). The results can be used to develop management plans and conservation programs for both species in the study area.

Growth of the Cuvier's dwarf caiman *Paleosuchus palpebrosus* during the first 18 months of age at The Dallas World Aquarium, Dallas, Texas, USA

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Abstract

The Cuvier's Dwarf Caiman (*Paleosuchus palpebrosus*) is the smallest living crocodilian and is very common in the pet industry. Because the demand of the pet trade is covered by the

exportation of wild caught hatchlings, there is little knowledge about their growth under human care or in wild populations. We measured 10 individually marked *P. palpebrosus* hatched at the DWA bimonthly during their first 18 months of age (total length in mm and weight in g). The Dwarf caimans were kept together and split into two groups at the age of 12 months until the end of the study. All the dwarf caimans were kept under the same husbandry parameters and were fed on calcium dusted crickets, mosquito fish, and live shiners five days a week. A basking area was provided 12 hr./day under a UV lamp, and hiding spots were provided within a cinderblock in the tub. Water and waste were siphoned every day from the water area (60 x 40 cm) of the tub (100 x 55 x 40 cm). Water depth was 10 cm. Dwarf caimans increased their TL 100% from hatching until the age of 18 months and their weight increased 900% in the same time period. We conclude that this species has a very slow growth rate in comparison with other crocodilians the authors have had experience with. Comparing the results of *Paleosuchus palpebrosus* with *Crocodylus intermedius* growth during the first year, the smallest crocodilian in the Americas increased its body length 0.7 times since hatching and its body weight 5 times, while the largest crocodilian in the Americas increased 3 times and 28 times respectively. This species has lower space and food requirements compared to fast-growing crocodilians.

Why so salty: evolutionary and conservation implications of analyzing physiological stress in *Crocodylus acutus* and *C. moreletii* hybrid zones

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Abstract

The incorporation of alleles from one species into the gene pool of a second – or introgressive hybridization – is a subject of controversy due to its constructive and destructive force. It can enhance adaptability and facilitate rapid radiation by introducing genetic variation, but can also drive rare taxa to extinction through loss of local adaptation or genetic swamping. While natural hybridization is a known evolutionary process, contemporary human-mediated hybridization has been established as a threat to biodiversity. High levels of introgression between the saltwater-adapted American crocodile (*Crocodylus acutus*) and freshwater-adapted Morelet's crocodile (*Crocodylus moreletii*) have been recorded in sympatric areas throughout Central America, revealing evidence of multigenerational hybrids across the Gulf of Mexico and parts of the Caribbean. While this hybridization has been established as an ancient process, anthropogenic impact has been proposed to may be speeding up and spreading the hybrid boundaries beyond historical hybrid zones and farther than the boundaries of any one species. Escalating reports of hybridization in Belize has raised concerns among conservation stakeholders regarding the preservation of each species' genetic integrity. With both species being listed as highly threatened within Belize, decreased protection due to ambiguous conservation laws for hybrids increase the vulnerability for both the animals and their environment. In order to address the evolutionary and conservation implications from this hybridization, the goal of this study is to: (1) identify and characterize population structure and age of admixture between *C. acutus* and *C.*

moreletii hybrids in Belize; (2) determine if hybridization between *C. acutus* and *C. moreletii* have introgressed genes associated with salinity-tolerance into *C. moreletii*/hybrid genome; and (3) determine if phenotypes introduced via hybridization between *C. acutus* and *C. moreletii* are adaptive. As a preliminary analysis, I compared environmental salinity taken at capture locations for each putative species to assess for baseline salinity tolerances. Significant differences in environmental salinities were found between morphologically distinguishable *C. acutus* and *C. moreletii*, as well as between *C. moreletii* and hybrids. For future work, I will use genome-wide association studies with population genomic analyses to reconstruct the magnitude and timing of introgression, and identify phenotype associated genes – particularly involving salinity tolerance across species genomes. By investigating hybridization in natural populations, my study will not only elucidate aspects of crocodilian evolution and biology, but with the onset of climate change, habitat loss, and depleting resources, evaluate the adaptive potential of hybridization for the crocodiles in a rapidly changing environment.

