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PROCEEDINGS OF THE FORTY-FIRST SYMPOSIUM ON SEA TURTLE BIOLOGY AND CONSERVATION

March 18 – 24, 2023
Cartagena de Indias, Colombia

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A PDF version is available on the International Sea Turtle Society website, https://www.internationalseaturtlesociety.org/publications/proceedings/

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PRESIDENT'S WELCOME

41st Symposium on Sea Turtle Biology and Conservation

18-24 March 2023, Cartagena, Bolivar, Colombia

By Diego F. Amorocho

WELCOME

Dear Sea Turtle Symposium attendees,

I am delighted to welcome you to my home, Colombia, the second most diverse country in the world. Colombia is a land full of unique natural and cultural wonders. It is only in Colombia where you can lay on the beach and at the same time look up and see the majestic snowed mountains of the "Sierra Nevada de Santa Marta", where you can visit rivers of multiple colors, or enjoy the thousands of bird species singing in the Amazon forest. Colombia is a privileged land with shores along the Caribbean Sea and the Pacific Ocean, both of which are marine ecosystems that provide fundamental services not only to the species that inhabit them, but also to many coastal communities and inland populations.

The biodiversity value of our waters is extremely high, and sea turtles play a vital role in their conservation. Sea turtles are so important, that every year a group of experts meets to learn about updates on their status, research and management, exchange knowledge and experiences, with the sole purpose of furthering the conservation of these species. Today we initiate the 41st Annual International Sea Turtle Symposium, and I feel very proud to host participants from more than 70 countries in the beautiful city of Cartagena, a city recognized by the UNESCO as a World Heritage Site.

As president of the International Sea Turtle Society (ISTS), we wanted our motto "Bridging communities and technology for marine turtle conservation" to highlight the importance of connecting and raising awareness in people that work towards the conservation of marine resources. By doing so, together we can achieve the protection and maintenance of sustainable processes, using the technology available nowadays to facilitate the tools and knowledge necessary to overcome future challenges and connect new generations to sea turtle conservation.

Sea turtles currently face multiple human and natural pressures, that have led to the decrease of many populations and the degradation of critical habitats for their survival. But not all hope is lost, as there are also multiple sea turtle conservation success stories. Both scenarios provide a myriad of reasons to continue fighting for sea turtle conservation in this new decade. I hope that by celebrating the 41st Annual International Sea Turtle Symposium you will gain the opportunity to learn, create strong bonds with new and old friends, and enjoy all the color and flavor the Caribbean has to offer!

¡¡Bienvenidos!!

Diego Amorocho, PhD.
President, International Sea Turtle Society

PRESIDENT'S REPORT

Summary Report – 41st International Sea Turtle Symposium (2023)

By Diego Amorocho, Symposium President

The 41st International Sea Turtle Symposium (ISTS41), held in Cartagena, Colombia, marked a historic and dynamic gathering of the global sea turtle conservation community. Organized under the leadership of President Diego Amorocho and supported by the International Sea Turtle Society (ISTS), this edition was notable not only for its scientific and cultural richness but also for the inclusive and regionally grounded approach it brought to the forefront. This was the second time the symposium was held in South America, and the first in Colombia, symbolizing a broader commitment to supporting conservation initiatives in the Global South.

Over 700 participants from more than 60 countries—including scientists, conservation practitioners, policymakers, Indigenous and Afro-descendant leaders, students, NGOs, and international agencies—gathered in Cartagena for a week of intensive workshops, scientific presentations, policy dialogues, and community networking. The symposium theme, "Bridging Communities and Technology for Marine Turtle Conservation," aimed to highlight the importance of integrating traditional ecological knowledge, community engagement, and emerging technologies to address the increasingly complex threats to sea turtle survival.

Program Highlights

ISTS41 featured a rich and diverse agenda, with 12 pre-symposium workshops addressing timely and critical themes:

- Sea turtle trafficking and illegal trade in Latin America and the Caribbean
- Use of drones and AI in sea turtle research and monitoring
- Sea turtle rehabilitation and veterinary care
- Community-based conservation and gender inclusion
- Marine turtle biotelemetry and movement ecology

These workshops were designed to build capacity among practitioners and promote south-south collaborations. Importantly, many were facilitated in both Spanish and English, reflecting the regional linguistic diversity.

The scientific program featured more than 300 oral and poster presentations across thematic sessions including bycatch reduction, nesting biology, genetics, climate change, habitat protection, and conservation policy. Keynote speakers brought unique perspectives and inspiration to the event:

- Héctor Barrios-Garrido shared the evolution of community conservation in the Latin American and Caribbean region, grounded in Indigenous knowledge.
- Brad Nahill offered practical strategies for sustainable fundraising and nonprofit management.
- Luis Germán Naranjo explored public-private conservation partnerships in Colombia.
- Roderic Mast launched the 2023 State of the World's Sea Turtles (SWOT) Report, underscoring global trends and key findings from turtle hotspots around the world.

Cultural and Social Impact

ISTS41 took special care to celebrate the cultural heritage of Colombia and the region. The opening ceremony featured Afro-Caribbean music and dance, and the local organizing committee worked closely with Afro-Colombian and Indigenous community leaders to ensure meaningful participation and representation throughout the week.

Local women's groups, fishers' cooperatives, and youth leaders from coastal communities across Colombia attended and contributed, enhancing the event's relevance for grassroots conservation. A market fair showcasing sustainable marine-themed crafts and regional foods added further dimension to the gathering, supporting local livelihoods.

Legacy and Partnerships

ISTS41 left a lasting impact on regional sea turtle conservation by strengthening networks and launching new collaborations. Highlights included:

- The development of a regional working group to tackle illegal trade of sea turtle products.
- Strengthened ties with Colombian universities and research centers, fostering student engagement.
- Strategic partnerships with regional NGOs and government agencies such as INVEMAR and CORALINA.
- Plans for increased training in satellite tracking, community education, and climate adaptation for turtle nesting beaches.

The Symposium also emphasized a gender-equity approach and promoted the leadership of women in marine conservation—reflected in the high number of women leading workshops and presenting research.

ISTS41 was a resounding success, not only for its scientific content but also for its regional relevance, cultural inclusiveness, and commitment to capacity building. It exemplified a holistic model of conservation that values both cutting-edge science and the voices of those on the front lines of sea turtle protection. The Cartagena symposium will be remembered as a milestone in strengthening community-driven, collaborative, and equitable conservation worldwide.

For the entire report with images please see, Marine Turtle Newsletter No. 166, 2023, 28-33pp.

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Regional Chair – Asia	Andrea Phillot
Regional Chair – Oceania/Pacific	Mark Hamann
Regional Chair – USA and Canada	Kelly Stewart

Regional Meeting	Organisers
Africa	Manjula Tiwari, Angela Formia, Andrews Agyekumhene, and Jacques Fretey
Caribbean (WIDECAST)	Karen Eckert
Indian Ocean and Southeast Asia (IOSEA)	Lalith Ekanayake and Zahirul Islam
Latin American Meeting (RETOMALA)	Raúl García, Jimena Gutierrez-Lince, Daniela Rojas-Cañizales, Juan Manuel Rguez-Baron, and Héctor Barrios-Garrido
Mediterranean Meeting	Sandra Hochscheid, Imed Jribi, Yakup Kaska, and Aliki Panagopoulou
Pacific Islands/Oceania	Irene Kelly
IUCN-SSC Marine Turtle Specialist Group (MTSG)	Roderic Mast and Paolo Casale
Laúd OPO Conservation Network	Bryan Wallace, Velkiss Gadea, and Karen Eckert

BOARD OF DIRECTORS AND THEIR END OF TERMS

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Ecological Associates Inc
Sea Turtle Week
Pendoley Environmental
The Turtleman Foundation
Artesanías Tortugas sin Fronteras
Hilton Cartagena
Universidad del Sinú

AWARDS

ARCHIE CARR STUDENT AWARDS

Student Awards for Poster and Oral Presentations at ISTS41, Cartagena, Colombia:

Category	Format	Prize	Student	Institution	Presentation Title
Biology	Oral	Winner	Katrina Phillips	University of Central Florida	"Lost years" sea turtle dispersal in the Gulf of Mexico
Biology	Oral	Runner up	Makayla Kelso	The Ocean Foundation	Hawksbill nesting trends increased significantly at Sandy Point National Refuge, St. Croix over 30 years
Biology	Poster	Winner	Samantha Kuschke	University of Tennessee, Knoxville	Impacts of a warming world: how incubation temperatures relate to blood values and preliminary microbiota findings in leatherback sea turtle hatchlings and post hatchlings
Biology	Poster	Runner up	Taylor Brunson	University of the Virgin Islands	Identifying space use and foraging patterns of juvenile green sea turtles (*Chelonia mydas*) in a *Halophita stipulacea*-dominated bay using a fine scale positioning acoustic array
Conservation	Oral	Winner	Kayla Marie Burgher	Arizona State University	Global patterns of illegal marine turtle exploitation
Conservation	Oral	Runner up	Keilor Cordero	Menendez Pelayo International University	Fast growing urban areas as potential drivers of sea turtle nest predation
Conservation	Poster	Winner	Ademir da Silva Maruyama	Universidade Federal do Rio Grande	At-sea mortality estimates of loggerhead turtle in Southern Brazil from stranding data
Conservation	Poster	Runner up	Katie Ayres	University of the Virgin Islands	St. Thomas beaches may be critical male-producing habitat for hawksbills in the United States Virgin Islands

ISTS AWARDS 2020 AND 2023

ISTS Lifetime Achievement Awards
2020: Larry Crowder, Karen Eckert, and Barbara Schroeder
2023: Jacques Fretey, Kenneth J. Lohmann, and Fernando Manzano "Papá Tortuga"

ISTS Champions Awards
2020: Karumbé Tortugas Marinas de Uruguay, Marine Turtle Newsletter, Kimberly Stewart, and Pedro Vernet
2023: Verdiazul Costa Rica

The Ed Drane Award for Volunteerism
2020: None
2023: Carl W. Stearns

ISTS President's Awards
2020: None
2023: Asociación Caguama, Richard Reina, and Héctor Barrios-Garrido

GRASSROOTS CONSERVATION AWARD
Wayuu Indigenous Community
The Wayuu Voices: A changing connection with marine turtles

OPENING REMARKS, AND KEYNOTES

OPENING REMARKS

Diego Amorocho, President, International Sea Turtle Symposium

Ximena Rojas Giraldo, Director, Office of Marine, Coastal and Aquatic Resources Affairs (DAMCRA), Ministry of Environment and Sustainable Development, Republic of Colombia

Héctor Barrios-Garrido, Adjunct Researcher / Co-Founder, TropWATER / Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela

Brad Nahill, President and Co-Founder, SEE Turtles

KEYNOTE ADDRESS

Roderic Mast, President and CEO, Oceanic Society

Luis Germán Naranjo, Conservation and Governance Director, WWF Colombia

CLOSING REMARKS

Diego Amorocho, President, International Sea Turtle Symposium

SPECIAL FEATURES

SPECIAL SESSIONS

Wildlife Crime: Illegal Trade in Marine Turtles.
Moderator, Christine Hof
Panelists, Jesse Senko, Héctor Barrios-Garrido, Nicholas Pilcher, and Brad Nahill

How Can Technology Improve Current Conservation Efforts?
Moderator, Jeffrey Seminoff
Panelists, Andrews Agyekumhene, Claire Jean, Lourdes Martínez-Estévez, and Bárbara Sellés-Ríos

The Ultimate Goal of Hatcheries: A Balance Between Business and Conservation.
Moderator, Nicholas Pilcher
Panelists, Eblin Pérez Castillo, Gustavo Lara, Jeanette Wyneken, and Diego Amorocho

Community-Based Conservation of Marine Turtles: The Next Generation.
Moderator, Adriana Cortés-Gómez
Panelists, Ruth Nibeth Martínez, Jordano Palmar, Neca Marcovaldi, and Alexandre Girard

WORKSHOPS (see workshop descriptions)

Workshop 1: A Strategy Framework on the Development of Solutions to Address the Key Threat of Sea Turtle Trafficking and Direct Take in the Caribbean, Central and South America.
Organiser: Ann Marie Lauritsen

Workshop 2: Drones and Sea Turtles.
Alan Rees, Ray Carthy, Thane Wibbels, Nerine Constant, and Natalia Teryda

Workshop 3: Sea Turtle Medicine and Rehabilitation.
Organiser: Daniella Freggi

Workshop 4: Reducing Bycatch by Building Capacity for Collaborative Research among Fishers and Conservationists.
Organisers: Michel Anthony Nalovic and Juan Manuel Rguez-Baron

Workshop 5: Designing Behavior Change Campaigns for Sea Turtle Conservation.
Organisers: Roderic Mast, Rachel Smith, Brian Hutchinson, and Ashleigh Bandimere

Workshop 6: The Climate-Threats Matrix: Understanding and Quantifying the Interactions of Cumulative Stressors with Climate Change and the Resulting Impacts on Sea Turtles.
Organiser: Matthew Lettrich

Workshop 7: Applications of Sea Turtle Reference Genomes for Research and Conservation Management.
Organisers: Blair Bentley, Camila Mazzoni, and Lisa Komoroske

Workshop 8: Student Committee Workshop: Career Paths and Key Approaches to Prepare and Succeed in the Sea Turtle World.
Organisers: Renato Bruno, Matthew Ramirez, and Gabriela Arango

Workshop 9: Male Sea Turtles: Current Global Conservation and Research Efforts.
Organisers: ProOcean Marine Research Conservation and Innovation and Archie Carr Center for Sea Turtle Research

Workshop 10: 4th Workshop on Plastic Pollution and Sea Turtles.
Organisers: Daniel González-Paredes, Alejandro Fallabrino, Andrés Estrades, Mark Hamann, Brendan Godley, and Emily Duncan

Workshop 11: Future Technologies for Large-scale Monitoring of Marine Turtle Nesting Populations.
Organisers: Liliana Poggio Colman and Ana Rita Patricio

Workshop 12: Strengthening Community-based Environmental Education Through Efficient Use of Technological Communication Tools.
Organisers: Amalia María Cano-Castaño, Anjelika Solé Abdo Abou Issa, Antonio Trujillo, Diana del Pilar Ramírez, and Georgina Zamora.

VIDEO NIGHT

The Video Night is a great opportunity to see other sea turtle projects around the world and learn about their education, research and conservation programs, learn from other sea turtlers' communication experiences, and just enjoy a night of fun and interesting sea turtle videos.
Chairs: José Urteaga, Jimena Gutiérrez-Lince, and Ana Henríquez

It's Turtle Time! - Carol McCoy
Country: United States of America

A Tale of Two Species - George Shillinger
Country: United States of America

Build a Better Box for Sea Turtles - Katherine Comer Santos
Country: México

The Dangerous Life of a Leatherback - Soraya Wijntuin
Country: Suriname

Leatherback Turtles: A Regional Action Plan for The Nwa Leatherback Population - Soraya Wijntuin
Country: Suriname

French Guiana Sea Turtle Cartoon Spot - Mathilde Lasfargue
Country: French Guiana

French Guiana Sea Turtles Network - A Vision About Sea Turtles: Meeting Kwata - Mathilde Lasfargue
Country: French Guiana

La Caminata - David Godfrey and Georgina Zamora Quílez
Country: Costa Rica

La Voz del Mar: Hope For Hawksbill Turtles - Melissa Valle and Kelly Hogan
Country: El Salvador

Turtle Conservation in Lamu, Kenya - Hashim Said
Country: Kenya

Brigada Comunitaria Tortuguera de Puerto Morelos - Erika Yazmin Hernández Ortiz
Country: México

Sea Turtle Research and Conservation in The Bijagós Archipelago - Rita Patrício
Country: Guinea-Bissau

Menos Plástico es Fantástico en Mahahual - Ana Antillanca Oliva
Country: México

The Banc D'arguin in Mauritania, A Major Foraging Ground for Green Turtles - Rita Patrício
Country: Mauritania

Strengthening Sea Turtle Conservation in Colombia - Juan Manuel Rguez-Baron, Roderic Mast
Country: Colombia

Monitoreo Tortuga Carey Cozumel - RobertoLuis Herrera Pavón
Country: México

First Sea Turtle Research Surveys in Carriacou, Grenada - Paul Jobsis, Kate Charles, and Kenrith Carter
Country: Grenada

Open Season Documentary Trailer - Kenrith Carter and Kate Charles
Country: Grenada

Karumbé en Tiktok: Los Videos más Virales Sacando Epibiota - Alejandro Fallabrino
Country: Uruguay

Primera Eclosión de Tortuga Laúd en Ecuador - Kerly Briones
Country: Ecuador

Fishermen "The Cornerstone of Marine Turtle Conservation" - Hamed Mallat
Country: Tunisia

Tortugas, Poesía al Mar - Gilberto Borges Guzman
Countries: Brasil, Venezuela, Costa Rica

Cayman Turtle Centre's Conservation Efforts - Vandanaa Baboolal
Country: Cayman Islands - Grand Cayman

Nelson Mandela University Turtle Trotters - Amanda Robbins
Country: South Africa

Cretaceuspark - Diana del Pilar Ramirez Acosta
Country: Colombia

Campamento ASUPMATOMA: 1995-2022 - Rene Pinal and Abilene Colin
Country: México

Proyecto de Conservación de Tortugas Marinas en Playa La Barqueta, Provincia de Chiriquí - Juan Blas and Cristina Ordoñez
Country: Panamá

Turtle Scott - Scott Crystal
Country: Panamá

Viviendo con Pasión en San Cristóbal - Zulema Guevara Oviedo
Country: México

Bangkaru Sea Turtle Conservation Program - Current State and Threats - Pavel Zoubek
Country: Indonesia

A Journey to Northern Chile: Looking for Leatherbacks - Ilia Cari
Country: Chile

Oca in Taiwan - Rosa Hsieh
Country: Taiwan

Incineración de Las Conchas. Una Nueva Acción De Cuba Por La Conservación - Raidel Borroto
Country: Cuba

SPEED CHATTING WITH THE EXPERTS

This is a fundraising function that provides a way for symposium newcomers and veterans alike to spend time chatting with an all-star gathering of sea turtle aficionados and experts. It is intended to be an "ice-breaker" for getting to know people you've always wanted to meet but have never approached. Speed Chatting sign-up will be fully virtual this year and is on a first- come, first-serve basis.

Chairs: Gabriela Arango, Renato Saragoça Bruno, Matthew Ramirez, Janie Reavis, Kirsty Scott, Lyndsey Tanabe

Experts: Camryn Allen, Alejandro Fallabrino, Alexander Gaos, Daniel González-Paredes, Frank Paladino, Felix Moncada, Miguel Reyes, Manjula Tiwari, Bryan Wallace, Alan Zavala, and Kate Mansfield

TURTLE TRADING POST

This event is open to students, travel grant recipients, NGOs, and groups in countries experiencing economic, environmental, and/or humanitarian hardship. The idea is for researchers with unneeded, gently-used research gear to donate it to those who can give it a second life.
Chair: Kate Mansfield

SILENT AND LIVE AUCTIONS

Proceeds from both the Silent and Live Auctions go toward travel grants for the next symposium. Chairs: Roderic Mast, Marina Zucchini, Ashleigh Bandimere, Pati Villegas, Jenn Homcy, Cundy Vargas

ART MURAL

With the motto of the symposium "Bridging communities and technology for marine turtle conservation", and as part of the legacy that the symposium wanted to leave in the city of Cartagena, we thought of an artistic work that promotes the importance of sea turtles for ecosystems and the important role communities play in their conservation. For this great mission, The Turtleman Foundation, Artesanias Tortugas Sin Fronteras, and the Hilton Cartagena Hotel joined our team as we commissioned the artist Akilles to capture our legacy in a beautiful mural.

ABSTRACTS

Abstract titles marked with an * at the beginning of the title denote an Oral Presentation.

ANATOMY, PHYSIOLOGY, AND HEALTH

DIVERSITY OF EPIBIONTS IN THREE SPECIES OF SEA TURTLES IN THE STATE OF GUERRERO, MEXICO

David Israel Almazán[1], Ildefonso Enciso[2], and Cesar Daniel Jiménez[1]

[1]*Universidad Autónoma del Estado de Morelos*
[2]*Universidad de Guadalajara*

Large marine vertebrates with pelagic habits, such as cetaceans and sea turtles, represent a unique habitat for the growth of benthic organisms. In the latter case, the Olive Ridley turtle *Lepidochelys olivacea* (Eschscholtz, 1829) constitutes, like other sea turtles, an excellent substrate for a wide variety of marine epibionts. The set of epibionts on the different species is considered a true floating ecosystem. Although these epibiont organisms are found in the seven species of sea turtles, a particular case is that of the *Caretta caretta* turtle, which, according to some authors, is the most likely to be colonized by both plant and animal epibiont organisms. Likewise, it has been documented that *Caretta caretta* harbors more extensive and diverse epibiontic communities than any other species. The presence of epibionts can be attributed to some natural factors, such as the molting of the scales in the shell, which causes irregularities and small counterflows that provide the epibionts with adhesion areas and relatively protected habitat, mainly for those species of invertebrates that are not very tolerant of the turbulence of the ocean. Knowledge of the taxonomic composition, distribution patterns, and abundance of these epibiont species represents an essential element better to understand the relationship between these hosts and their epibionts. Hence, this work aims to know the diversity of epibionts in three sea turtles: *Lepidochelys olivacea*, *Dermochelys coriacea*, and Chelonia mydas on a beach in the tropical Mexican Pacific. This work was carried out in Playa Ventura, Guerrero, from September 2013 to January 2014 and from October 2014 to January 2015, during which epibionts were recorded in three species of turtles: *Lepidochelys olivacea*, *Dermochelys coriacea* and *Chelonia mydas*. These epibionts were detached from the hard parts (carapace and plastron) and the soft parts (fins and neck). A total of 14 species of epibionts, including a filamentous alga, were recorded in 302 reviewed female turtles.

ESTIMATING BODY CONDITION AND BODY MASS OF NESTING LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) USING NONINVASIVE AERIAL PHOTOGRAMMETRY AND 3D MODELLING

Derek M. Aoki[1,2,3], Justin R. Perrault[2], Annie Page-Karjian[1], Heather Harris[3], George L. Shillinger[3], and Duncan J. Irschick[4]

[1]Florida Atlantic University, Harbor Branch Oceanographic Institute, Fort Pierce, Florida, USA
[2]Loggerhead Marinelife Center, Juno Beach, Florida, USA
[3]Upwell Turtles, Monterey, California, USA
[4]University of Massachusetts at Amherst, Amherst, MA, USA

Comprehensive physical examinations of sea turtles are often used to initially assess sea turtle health, which includes evaluation of body condition. This can be estimated objectively using body mass and morphometric measurements, or with a subjective body condition score based on plastron shape and the size of observable fat deposits and muscle mass around the neck, tail, and bases of flippers/limbs. Aerial photogrammetry can be used to noninvasively measure specific morphological features of animals that are impractical to capture; however, no study has implemented this method to estimate sea turtle body condition and body mass because the hard carapace of cheloniid sea turtles does not change shape relative to their nutritional status. Conversely, leatherback sea turtles (*Dermochelys coriacea*) have a pliant carapace that expands and contracts with changes in body condition. In addition, leatherbacks can weigh >600 kg and are logistically difficult to capture at sea and weigh on land during nesting season. Aerial photographs can be used to recreate body shapes and masses through 3D models, which can provide basic relationships between animal volume and mass to estimate body condition. Here, we provide a noninvasive methodology in which aerial photogrammetry and 3D modelling are used to estimate leatherback body condition and body mass. Full-body images of a leatherback nesting during daylight hours were used to create the 3D leatherback model, which integrated morphometric and photogrammetry data using Blender to create an initial 3D mesh. The mesh was then retopologized to ensure an accurate shape for the final product. In addition, full-body images of 15 nesting leatherbacks were taken by a DJI Phantom 4 Pro drone on Juno Beach, Florida, USA during the 2021 and 2022 nesting seasons. Eight leatherbacks that were photographed were weighed to obtain body mass. All images were taken at an altitude of 6 m directly above the turtle with red-filtered lights. Images were processed in Adobe Lightroom and used to refine the 3D model. We confirmed the accuracy of the aerial images and 3D model by comparing digital measurements with known mass and measurements (minimum and maximum curved carapace length and width, length and width of the turtle's head and front and rear flippers, and body and neck circumferences) taken directly on the turtle using a soft tape measure, and with assigned body condition scores from physical examination. Once complete, the 3D volumetric model can be manipulated to calculate volume of individual leatherbacks with known morphometric measurements, allowing us to make estimations between the turtle's volume and mass, for us to estimate body condition more accurately. Results will introduce a noninvasive method to quickly estimate body mass and condition of leatherbacks and possibly eliminate the need to physically capture the turtle on land and at sea. The 3D model will also be placed on an open-access website, which will enable others to easily access, view, and download the models for scientific or educational use.

*METABOLIC COST OF THE SYNCHRONOUS NESTING IN OLIVE RIDLEY SEA TURTLES

B. Gabriela Arango[1], David C. Ensminger[2], Diana Daniela Moreno-Santillán[1], Martha Harfush-Meléndez[3], Elpidio Marcelino López-Reyes[3,4], José Alejandro Marmolejo-Valencia[5], Horacio Merchant-Larios[5], Daniel E. Crocker[6], and José Pablo Vázquez-Medina[1]

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Olive ridley sea turtles, *Lepidochelys olivacea*, exhibit a polymorphic reproductive behavior, nesting solitarily or in mass aggregations termed "arribadas", where thousands of individuals nest synchronously. Arribada nesting provides fitness benefits including mate finding during nearshore aggregations and predator satiation at the time of hatching, but it is unknown if such benefits come with a physiological cost. We used plasma metabolite profiling, stable isotope analysis, biochemical and endocrine assays to test whether metabolic parameters differ between nesting modes, and if arribada nesting is associated with increased levels of oxidative damage compared to solitary nesting. Arribada nesters were bigger and had higher circulating thyroid hormone levels than solitary nesters. Similarly, pathways related to phospholipid and amino acid metabolism, catabolic processes, and antioxidant defense were enriched in individuals nesting in arribada. Stable isotope signatures in skin samples showed differences in feeding zones with arribada nesters likely feeding on benthic and potentially more productive grounds. Arribada nesters had increased levels of plasma lipid peroxidation and protein oxidation products compared to solitary nesters. These results suggest that metabolic profiles differ between nesting modes and that oxidative stress is a trade-off for the fitness benefits associated with arribada nesting.

DIET COMPOSITION OF GREEN TURTLE JUVENILES WITH FIBROPAPILLOMA IN A FEEDING AREA OF VILLA CLARA, CUBA

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Distribution and environmental quality of development areas of marine turtles' juveniles are still little known worldwide and within the Cuban archipelago. There are also no recent studies on *Chelonia mydas'* diet in Cuba and it is unknown what juveniles consume within the Cuban platform and if fibropapilloma disease could affect their feeding behavior. Therefore, the objectives of this work were to determine the elements present in the diet of green turtle juveniles in a feeding area north of the Cuban platform and compare its frequency of occurrence in samples of stomach contents and feces. To this end, a micro-histological analysis of the digestive content (stomach and feces) of animals with fibropapilloma that were found stranded in the protected area "Lanzanillo-Pajonal-Fragoso on the north coast of Villa Clara. The correspondence between the elements found in the diet and their availability in the habitat, makes it impossible to determine if the turtles have preference between *Thalassia testudinum* and *Syringodium filiforme*. However, there is a greater proportion of *Halodule wrightii* in the diet with respect to its availability in the area, suggesting an apparent preference for this species of seagrass. The presence

of *Chondrila caribensis* in the diet of juveniles in Villa Clara, correspond with its abundance as an epiphyte in the seagrass beds of the area suggesting that *C. mydas* may adopt opportunistic behavior when a resource occurs at high densities on a local scale.

EVALUATION OF THE METALLIC CONTAMINATION DEGREE IN GREEN TURTLE'S FEEDING AREA LANZANILLO-PAJONAL-FRAGOSO, CUBA

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The present work evaluates the contamination level by metallic elements in the marine sediments of Lanzanillo-Pajonal-Fragoso Wildlife Refuge, Villa Clara province, Cuba. Eight sampling stations were selected and the levels of Cr were quantified by X-Ray Fluorescence and Zn, Cu, Cd, Fe, Pb, Ni, Mn and Co by Flame Atomic Absorption Spectrophotometry. The chemical pre-treatment of the samples was carried out following the modified ISO 11466 standard method and some validation parameters of the analytical technique were evaluated, showed the accuracy and feasibility of the method. To evaluate the study area contamination the International Sediment Quality Guide of the National Oceanic and Atmospheric Administration and four environmental contamination indexes were used: two enrichment indexes (the enrichment factor and the geoaccumulation index), an ecological risk index (the average ratio of moderate risk effects), and a contamination index (the modified degree of contamination). The results showed that the elements representing the greatest risk are Ni and Cr, since they exceed the concentration that causes Moderate Biological Effects. According to the evaluated indexes, it can be concluded that there is a presence of anthropogenic contamination in the protected area that may be affecting the turtle's health due to the stress that they cause in them. The site of highest risk was Jácate and the element that more contribute to the metallic contamination is Cr, although significant values were obtained for Ni, Co and Fe.

CONSERVATION LESSONS FROM CONGENITAL MALFORMATIONS AND NEST MANAGEMENT OF THE KEMP'S RIDLEY (*LEPIDOCHELYS KEMPII*), A NORTHWESTERN GULF OF MEXICO ENDEMIC SEA TURTLE

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Sea turtle conservation strategies focus on improving reproductive success, which is determined by the number of hatchlings recruited into the marine environment. Successful completion of embryonic development depends on high physical fitness and an optimal development environment. Genetic or environmental alterations during early development can drastically affect embryonic processes or generate congenital malformations. In wildlife, congenital malformations may signal emerging pathological threats, but whether the phenomena are broadly applicable across taxa, or have population-scale impacts, is

unknown. Congenital malformations in sea turtle embryos and hatchlings range from 0.2 to 2%, the highest rates occur in the olive ridley. Overall, nests with congenital malformations have higher mortality levels, suggesting an effect from intrinsic incubation factors likely associated with the female condition. *In situ* nests show lower congenital malformations and mortality levels than artificial nests. No congenital malformations prevalence information is available for Kemp´s ridley turtle, endemic to the Gulf of Mexico and the most endangered worldwide. We present results from detailed quantitative analyses of congenital malformations based on external anatomy observations in embryos and hatchlings of the Kemp´s ridley turtle at Rancho Nuevo beach, the most important nesting area in the Gulf of Mexico, involving two management nest strategies: hatchery and *in situ* nests. We examined 200 *in situ* and 200 hatchery nests during the 2019 nesting season. Hatchery nests were collected from "small arribadas" (from 100 to 170 nests) and *in situ* nests were collected from the largest arribada (around 4000 nests). Data recorded for each nest included: number of eggs, hatchlings (alive and dead), and eggs with or without embryonic development. Hatching and mortality levels were compared for nests with and without congenital malformations. Malformation frequency was evaluated with indices of (i) prevalence, as the proportion of eggs and nests with at least one malformation, and (ii) severity, as the number of malformations per organism and nest. Overall, hatchery nests showed significantly higher mortality rates (including dead hatchlings inside the nest, eggs with obvious embryonic development, and eggs without obvious embryonic development), and lower hatching success than those observed in in situ nests. In both nest managements, mortality in nests containing malformed organisms was significantly higher than in nests without congenital malformations and therefore hatching success was significantly lower in nests with congenital malformations than those without congenital malformations. Comparison between nest managements showed that mortality and hatching levels were significantly higher and lower, respectively, in nests with congenital malformations for hatchery nests than from in situ nests. Prevalence was significantly higher in hatchery nests than those from in situ nests. No significant differences in severity were observed between nest managements. These differences could suggest an effect from intrinsic incubation factors (mainly temperature, gas exchange, moisture and handling time) in these nests perhaps associated with the micro-environment at each type of nest management. This research establishes the basis of congenital malformations (CMs) levels in Kemp's ridley turtle. Whether the observed malformation levels are normal or represent a health problem cannot be currently determined without long-term assessments.

CARE MANAGEMENT OF GREEN TURTLE HATCHLINGS FOUND DURING NEST EXCAVATION IN REUNION

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Discovered during the sixteenth century by the Portuguese, Reunion Island was described as a "turtle island" by sailors. But after decades of human exploitation, predator introduction and littoral urbanization, the population of green sea turtle (*Chelonia mydas*) has declined considerably in recent centuries, and very few nests have been reported. Since 2004, only two females have been nesting on the island's beaches. Thus, incubation and emergence from 24 nests were monitored where 1300 hatchlings emerged naturally. 72 hours after the first emergence, each nest was excavated. Alive hatchling in the nest or in the sand column are counted and released on the beach when they are "valid". "Injured" hatchling are transferred to the Kelonia Care Center. Since 2010, 422 hatchlings have been cared for. According to their condition, the majority of hatchlings (69%, n=422) were released within a week, once the yolk sac is entirely absorbed and the umbilicus sealed. 12,5% of stragglers, due to their poor condition, died mostly during the first

week. 18,5% are maintained in care center from 1 to 35 weeks. Neonates kept in the care center's tanks may developed those following pathologies: shell and skin infections, anorexia, weight loss, enteritis, hypovitaminosis A, lethargy and septicemia. Some of them may lead to the death of the individuals. Analyses of skin samples, mouth and wound swabs, stools or during necropsies allowed to isolate 12 bacteria strains, 3 types of parasites and 2 unidentified fungi species. Pathologies and their occurrence were characterized according to captivity conditions (water quality, diet, handling, sanitation protocol) and infectious agents found, and treatments provided. Rearing sea turtle hatchlings can be a very challenging task. Data collected during this ongoing study were compared with the literature in order to identify areas for improvement in our captivity conditions.

FIRST REPORT OF DESCOMPRESSION SICKNESS IN VENEZUELA: A CASE OF STUDY

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Incidental capture in fisheries is one of the major threats to sea turtle populations worldwide, with some of these interactions triggering decompression sickness (DCS). A critical aspect of this study was the diagnostic criteria for DCS through the necropsy technique, applied in the field in a remote area. In Venezuela, DCS had not been reported due to the lack of qualified personnel for its diagnosis and the prohibition on trawling in the country, although it continues to be practiced illegally in an artisanal way. An alive stranded loggerhead turtle (*Caretta caretta*) in Doral Beach at Puerto La Cruz City, Sotillo, Venezuela was reported to wildlife authorities. Due to the lack of rehabilitation facilities and specialized personnel in the area, it was decided to relocate the stranded animal into a shaded cool area at the dune, after 5 hours the turtle died. The carcass was relocated with wildlife authorities to Fundación La Tortuga facilities to develop a field necropsy. The turtle presents a 74 cm LCC, 75.2 cm WCC and an approximate weight of 50 to 60 kg. During the necropsy, common post mortem findings were observed such as bloating body, protruded eyes, and necrosis on the skin. Based on the macroscopic findings observed during the necropsy technique, it was concluded that the cause of death was DCS resulting from illegal trawling along the coast of Anzoátegui State. To our understanding, this finding has significant regional implications. We continue working with wildlife authorities and the private sector to prevent DCS, and a better understanding of fisheries interactions with sea turtles in the region.

EVIDENCE FOR HOST SELECTIVITY AND SPECIALIZATION BY EPIZOIC *CHELONIBIA* BARNACLES BETWEEN HAWKSBILL AND GREEN SEA TURTLES

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Chelonibia barnacles are epizoic, utilizing the exterior substratum of free-swimming marine megafauna as settlement sites. The species that make up the genus *Chelonibia*, also referred to as "sea turtle barnacles", are primarily specialized for, but not limited to, colonizing sea turtles. The relevant criteria for settlement by individual *Chelonibia* barnacles are currently not well understood. Two species of sea turtle barnacles were investigated to test the case of apparent selection for particular host species and elucidate the ecological relationships between host sea turtle and barnacle species. *Chelonibia testudinaria* and *Chelonibia caretta* differ moderately in morphology and lifestyle. Both species are known to settle on both green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles; however, *C. testudinaria* is >5 times more commonly found on green turtles, while *C. caretta* is >300 times more common on hawksbills. Two competing explanations for this asymmetry in barnacle incidence are either that the species' larvae are spatially segregated in mutually exclusive host-encounter zones or the barnacles' distributions overlap but their larvae behaviorally select different hosts from a common pool. We tested the latter indirectly by documenting the occurrence of adults of both barnacle species in two locations (SE Florida and Nose Be, Madagascar) where both turtle species co-mingle. For green and hawksbill turtles in both locations (Florida: $n = 32$ and $n = 275$, respectively; Madagascar: $n = 32$ and $n = 125$, respectively), we found that *C. testudinaria* occurred on green turtles only (percent occurrence – FL: 38.1%; MD: 6.3%), whereas the barnacle *C. caretta* was exclusively found on hawksbill turtles (FL: 82.2%; MD: 27.5%). These results support the hypothesis that the larvae of these barnacles differentially select host species from a shared supply. Biochemical differences in host shell material, conspecific chemical cues, external microbial biofilms, and other surface chemistry signals may be salient factors in larval selectivity. Alternatively, barnacle presence may vary by physical substrate structure and micro-environment. Dissimilarities in scute thickness, surface texture, and shell growth patterns between hawksbill and green turtles may present critical differences that influence disparities in attachment modes observed between these barnacles. In understanding the co-evolution of barnacles and hosts it is key to consider the ecologies of both hosts and epibionts in interpreting associations of chance, choice, and dependence. Further studies are necessary to investigate the population status and settlement spectrum of barnacles inhabiting sea turtles.

ANALYZING HEAVY METAL CONCENTRATIONS IN SEA TURTLES FROM MASSACHUSETTS AND THE MID-ATLANTIC BIGHT REGION

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Heavy metal pollution is a growing threat to marine life. Studies on various taxa show that increased exposure to certain heavy metals can have detrimental impacts on physical and reproductive fitness. As sea turtles are long-lived and highly migratory species, they can serve as possible indicator species for heavy metal pollution in marine ecosystems. To better understand trophic accumulation of heavy metals in sea turtles, we will compare heavy metal concentrations of sea turtle tissues and their prey. Specifically, we focused on loggerhead (*Caretta caretta*), green (*Chelonia mydas*) and Kemp's ridley turtles (*Lepidochelys kempii*) from Massachusetts and the Mid-Atlantic Bight region. We collected and analyzed blood samples from Kemp's ridleys (n=4), scute samples from Kemp's ridleys (n=30), loggerheads (n=54) and greens (n= 8), and skin samples from Kemp's ridleys (n=30), loggerheads (n=17) and greens (n=8). The Massachusetts samples were necropsied from cold stunning events whereas the Mid-Atlantic Bight region samples were live captured, sampled, and released. Our study investigates whether the respective sample types vary in heavy metal concentrations across the different species and sites. We analyzed these samples using an ICP-MS for the following heavy metals — Manganese, zinc, iron, lead, aluminum, chromium, cobalt, nickel, arsenic, silver, cadmium and selenium (Mn, Zn, Fe, Pb, Al, Cr, Co, Ni, As, Ag, Cd and Se). Our results show that many samples had Se below the detection limits, whereby the lowest concentrations were found in Kemp's ridley blood (mean ± SD wet weight; 0.179 ± 0.0307μg/g) and highest in green skin samples (2.18 ± 2.95μg/g). Se was however detected in all loggerhead scutes from the Mid-Atlantic Bight region at a relatively higher concentration of 11.4 ± 11.1μg/g. In scute and skin samples, Ag was the lowest heavy metals across all samples, with Kemp's ridleys having the highest concentrations of 0.0488 ± 0.0138μg/g in scute samples and 0.00921 ± 0.011μg/g in skin samples. Co was the second lowest across all species for scute samples, where the highest concentration was found in Kemp's ridleys (0.238 ± 0.379μg/g). Co was also second lowest in Loggerheads and Kemp's ridley skin samples (0.0160 ± 0.00831μg/g and 0.0268 ± 0.0287μg/g respectively). Al, Fe and Zn were found to have a wide range of concentrations. For Al and Fe, the greatest variability was in green scutes (140 ± 225 μg/g and 352 ± 505 μg/g respectively) and Kemp's ridley skins (25 ± 38.2 μg/g and 44.3 ± 60.7 μg/g respectively). For Zn, the greatest variability was found in Mid Atlantic Bight loggerhead scutes (173 ± 52.2 μg/g) and green skins (21.6 ± 9.23 μg/g). Our low Co concentrations and wide range of concentrations for Al, Fe and Zn are comparable to findings of other similar studies. We will also be collecting sea turtle prey samples in the near future from the Mid-Atlantic Bight region to investigate the effect of biomagnification on sea turtles. Such data can provide for better understanding on the amounts of incorporation of heavy metals in sea turtles, which is vital for future conservation efforts.

*HOW A THOUSAND COINS KILL "AOMSIN", A GREEN SEA TURTLE

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A 25-year-old female green sea turtle, named "Aomsin" (Translated: "Piggy Bank"), formerly lived in a public pond in Sriracha, Chonburi, Thailand, was brought to the Veterinary Medical Aquatic Animal Research Center of Excellence (VMARCE), Chulalongkorn University, Bangkok, Thailand, with the signs of abnormal swimming and severe depression. Upon the physical examination by veterinarians, symptoms of severe lethargy, abnormal buoyancy, and large plastron deformity with septic wounds were noted. The initial plain radiographs showed a large radiopaque mass in the gastrointestinal (GI) tract. Further computed tomography (CT) scan revealed that the mass was a pack of numerous coins accumulated in its stomach and intestine. Laboratory results showed an increase in liver enzymes and blood Nickel levels, which was 200 times higher than the normal range. A 7-hour long operation of gastrotomy and enterotomy via plastron approach was performed to remove coins at the Small Animal Teaching Hospital, Chulalongkorn University. Only the coin-removing procedure took 6 hours since each coin was partially attached to the serosal surface of the GI tract of the turtle. A total of 915 coins from many currencies, weighing 5 kilograms, were obtained. The surface of all coins turned black due to the corrosiveness of gastric acid, leading to heavy metal leaching and accumulation in the body. After the surgery, Aomsin was further treated for hepatitis and heavy metal toxicosis. She could swim and her appetite resumed back in a few days. However, 2 weeks later, Aomsin's symptoms suddenly worsen to severe depression, bloat, and abdominal pain. It was diagnosed as acute intestinal strangulation and volvulus due to intestinal motility in the increased abdominal space. An emergency operation was performed that day. However, Aomsin remained in COMA and died two days later. The cause of death was due to the unexpected GI complications plus the effect of prolonged heavy metal toxicity which weakened her body system, causing multiple organ failure and circulatory disturbances. The death of Aomsin has brought the awareness of the welfare of sea turtles in captivity to public attention. The cultural belief of throwing coins into turtle ponds to bring good luck was blamed to be the cause of Aomsin's death. The stress from having improper welfare in captivity also played a major role in causing this abnormal coin-eating behavior. The death of Aomsin has greatly impacted the improvement of public awareness of captive animal welfare and old beliefs both domestically and globally. This not only benefits to sea turtles but also other species of animals in captivity.

SURVEYING ANTIBIOTIC RESISTANCE OF GRAM-NEGATIVE BACTERIA ISOLATED FROM WILD-CAUGHT AND REHABILITATED GREEN SEA TURTLES (*CHELONIA MYDAS)* AND LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) OF FLORIDA

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Antibiotic resistance is a growing concern due to the improper use of antibiotics. Not only is antibiotic resistance increasingly occurring in human populations, but it appears to be spreading in wildlife populations as well due to their use and misuse in medicine, farming, and industrial settings, and the subsequent release into watersheds. The spread of pathogenic antibiotic resistant bacteria is also of great concern to marine wildlife, including both turtles in rehabilitation facilities and wild populations. This project examined the prevalence of antibiotic resistant bacteria in the gut microbiome of green and loggerhead sea turtles. Using cloacal swabs, wild-caught turtles were sampled from the St. Lucie Nuclear Power Plant and rehabilitation turtles were sampled from Gumbo Limbo Nature Center. Samples were plated and incubated using MacConkey agar to select for gram negative bacteria. Bacteria were then transferred to Mueller Hinton agar plates and tested for antibiotic resistance against six antibiotics which were selected to represent the main classes of antibiotics as well as the antibiotics frequently used in rehabilitation settings. 83.3% of samples were resistant or intermediately resistant to at least one antibiotic, and 27.7% of samples were resistant or intermediately resistant to three antibiotics. Interestingly, the microbiomes were most resistant to antibiotics commonly prescribed in humans, rather than those used primarily in Florida rehabilitation facilities. Specifically, 61.1% of samples were resistant to ampicillin, 27.7% of samples were resistant to azithromycin, 50% of samples were intermediately resistant to ciprofloxacin, 11.1% were resistant to tetracycline, and 16.6% were intermediately resistant to amikacin. This study intends to provide more information regarding the relationship between turtle health and the presence of antibiotic resistance in the gut of Florida sea turtles.

HEMATOLOGICAL PROFILE OF GREEN TURTLE (*CHELONIA MYDAS*) IN URUGUAY

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Hematological values are important tools to monitor the health status of animal. Marine turtles are affected by different diseases, some of them can go unnoticed at first sight and one of the main ways to identify them are hematological analyses. Currently, there are not hematological values baseline available for green turtle (*Chelonia mydas*) in Uruguay. The aim of the present work was to establish a reference range of hematological values for juvenil green turtles in the Uruguayan coast in order to provide a diagnostic tool in the assessment of health condition in this feeding ground. The specimens came from NGO Karumbe controlled captures in the Coastal- Marine Protected Area Cerro Verde e Islas de la Coronilla, Rocha, Uruguay during 2021-2022. All individuals were measured and weighed. Blood samples were collected from the jugular vein of 45 wild healthy turtles using a preloading 3ml disposable syringe with lithium

heparin and 21- gauge needle. Hematocrit (HCT) was determined using the microhematocrit method. The tubes were then spun in a microhematocrit centrifuge for 5 min at 12,000 rpm and the HCT was calculated using a hematocrit reader. Total counts of red blood cells (RBCs) were performed in a Newbauer chamber. The White blood cells (WBCs) total estimation was carried through the blood smears made at the time of collection of blood samples, stained with May-Grünwald-Giemsa technique. The reading was held in the optical microscope objetive lens of 40x. Estimated WBC was obtained by averaging the number of leukocytes per 10 field and multiplying by 1000. Leukocytes differential count was performed by counting 100 cells with 100x objetive oil. Thrombocytes were counted every 1,000 red blood cells on the blood smear. The average and SD values obtained in this study for the red series were HTC (%) 28 ± 6 (range 17- 40) and RBCs count (10^6/µl) 1,41± 0,6 (range 0,4- 3,4). For the white series WBCs (10^3/µl) was 10,7 ± 7,8 (range 2,4- 51). Leukocyte formula: heterophils (%) 33,1 ± 7,4 (range 17- 47); eosinophils (%) 19,4 ± 7,8 (range 9- 35); basophils (%) 0,9 ± 1,2 (range 0- 5); lymphocytes (%) 44,3 ± 12,3 (range 23- 72); monocytes (%) 2,1 ± 1,8 (range 0- 8) and thrombocytes count (10^4/µl) was 21,2 ± 6,9 (range 0,9- 43). These results are consistent with those of other authors. The values obtained in this study are baseline approach that could help to evaluate the health status of the green turtle in Uruguay.

COCCIDIOSIS IN GREEN TURTLES (*CHELONIA MYDAS*) OF SÃO PAULO, BRAZIL

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Coccidian parasites have been associated with severe enteritis and encephalitis in juvenile green turtles (*Chelonia mydas*), usually with high morbidity and mortality rates worldwide. Interoceanic dissemination and growing frequency and severity of outbreaks rise concern for coccidiosis in sea turtles. Here we describe four cases of coccidiosis in green turtles from Brazil based on histopathological, coproparasitological and molecular analyses. All animals were found alive in the southern coast of São Paulo state, in an important sea turtle feeding ground frequented year-round by the five sea turtle species that occur in the Brazilian coast. Necropsies were performed within 24h post-mortem, according to standard procedures. Representative tissue samples of main organs were collected and fixed in 10% neutral buffered formalin or frozen at -20ºC until analysis. All animals were juvenile, female green turtles, according to gross gonadal appearance and the curved carapace length (CCL), which ranged from 28.5 to 58.4 cm. All but one animal presented poor body condition, one being cachectic. All animals exhibited varying degrees of intestinal mucosa thickening, hyperemia, and hemorrhage, as well as white to yellow exudate and pasty and/or liquid fecal content. Three turtles had a large amount of gas in the intestines. Coproparasitological examination in one turtle revealed many coccidian oocysts. In the gastrointestinal tract, histopathological findings were hypertrophy and hyperplasia of mucosal epithelial cells (4/4), exudative enteritis, ranging from mucoid (2/4) to fibrinous (1/4), and meronts within the enterocytes (1/4). Molecular analysis (polymerase chain reaction) detected coccidian genetic material in the spleen of two cases and the small intestine of two other cases. One sequence obtained from intestine tissue indicated 100% of nucleotide similarity (E-value = 1e-174) with *Caryospora cheloniae* genotype 1 (Genbank accession no. KT361639), *Eimeriidae* sp. (Genbank accession no. MN450817) and *Schellackia* sp. genotypes 1 and 2 (Genbank accession no. KY046254 and KY046255, respectively). Additional pathologic findings in these turtles were cutaneous and systemic injuries indicative of fishery interaction (3/4) primarily involving acute cutaneous traumatic injuries and acute multiorgan hemodynamic alterations suggestive of shock, chronic lesions associated with wasting (1/4), digestive disorders (1/4) and endoparasitism, including spirorchidiasis (2/4) and gastric trematodiasis (1/4). One animal also had cutaneous fibropapillomatosis. This study has provided the first molecular detection of coccidiosis in green turtles of the Western South Atlantic Ocean and further demonstrates that young turtles in this region are vulnerable to this emerging disease. Additional stressors, such as concomitant infectious disease, environmental pollutants, and fishery interactions may impact negatively in their resilience to coccidiosis. These results may be of value to first responders, veterinarians, and diagnosticians, and may provide scientific basis for future medical and conservation efforts on green sea turtle populations in Brazil.

HEALTH ASSESSMENT OF HAWKSBILL SEA TURTLE (*ERETMOCHELYS IMBRICATA)* OF THE EASTERN TROPICAL PACIFIC

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Hawksbill sea turtle (*Eretmochelys imbricata*) currently is listed as critically endangered on the IUCN Red List. Particularly, the hawksbill population in the eastern Pacific Ocean is one of the eleven most threatened sea turtle populations worldwide. Although studies focusing on the distribution, biology, and population dynamics of hawksbill turtles in the nesting and foraging grounds of the eastern Pacific have increased in the last decade, there is still a lack of information about the health status of their populations. The aim of this study was to evaluate the health status of hawksbill turtles at two foraging grounds in the Eastern Tropical Pacific: The Islas Marias archipelago, located in the south of Gulf of California, and the coastline of Nayarit and Jalisco, México. During 2018, 2019 and 2021, 90 hawksbill turtles were captured, 75 of which were classified as juveniles, 5 as subadults and 10 adults. Most of the turtles showed a good physical condition, with no tumors, malformations, or fatal injuries. Additionally, body condition index (BCI) presented a mean of 1.255 (0.90-1.80) that categorized the population with excellent body condition. In order to assess the physiological parameters for hawksbill turtles, 50 blood samples were obtained by venipuncture from the dorsal cervical sinus. Plasma biochemical analytes were measured with a portable point-of-care analyzer, the VetScan VS2 using Avian/Reptile Profile Plus Rotor, which includes the following analytes: Total protein, albumin, glucose, aspartate aminotransferase (AST), creatine kinase (CK), bile acid, uric acid, sodium, potassium, calcium, and phosphorus. The values obtained are similar to those reported in other species of clinically healthy sea turtles in feeding areas. Compared with previous studies of hawksbill turtle, differences are observed in some parameters, possibly due to the fact that these studies analyzed nesting female populations, period during which the metabolism of these organisms changes due the vitellogenesis process. Hawksbill sea turtles from Mexican Pacific presented a good apparent condition, a very good body condition index and clinically no-show pathological problems, therefore, it can be concluded that this population presents a good state of apparent health. This information will contribute to improved care for captive turtles and serve as a baseline for wild turtle health and monitoring.

PERSISTENT ORGANIC POLLUTANT IN UNHATCHED EGGS OF *CHELONIA MYDAS* IN BRAZILIAN NORTHEAST COAST

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Persistent organic pollutants (POPs) were widely used as pesticide, electrical insulation and flame retardants, and they were also released as industrial by-products. POPs, such as organochlorinated pesticides (OCPs), polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs), are stable, have low degradability and are lipophilic, which favors their presence in the environment and bioaccumulation in organisms. The aim of the present study was to assess the POPs in unhatched eggs of green turtle (*Chelonia mydas*) because those contaminants accumulated in sea turtle females are transferred to their eggs and can interfere in their embryonic development and immune system. To achieve this goal, eggs, in good conservation condition and classified until the middle stage of development, were collected in 19 nests in Atol das Rocas Biological Reserve, located in the Brazilian Northeastern Coast. POPs were extracted in Soxhlet apparatus and quantitatively analyzed in a gas chromatograph coupled to a triple quadrupole mass spectrometer. PCBs were predominant, ranging, in ng g^{-1} wet weight (ww), from 0.132 to 1.96 with penta and tetrachlorinated as main congeners. For OCPs, the highest concentration was found for HCHs (0.001 to 0.193), mainly composed by γ-HCH (Lindane). HCB (hexachlorobenzene) were present in all samples, while Mirex and Chlordane appeared in 11 and 3 samples, respectively. DDTs (dichlorodiphenyltrichloroetane and derivatives) occurred in 8 samples and were constituted mostly by p,p'-DDE, the most stable and persistent derivative. The PBDEs, represented only by PBDE 47, were detected only in 3 samples. The results found are related to the feeding pattern of green turtle, as food is the main route of contamination by POPs. During adulthood, *C. mydas* is mainly herbivorous, which explains the presence of lighter congeners of PCB. The presence of Lindane in eggs is related to the intensive use of this pesticide in the Southern Hemisphere. DDTs had an intensive usage in South America to combat disease vectors and for agriculture. The low occurrence and concentrations for chlordane, Mirex and PBDEs probably reflect the punctual usage of these compounds in South America. Furthermore, the presence of POP in *C. mydas* eggs showed that sea turtles in Brazil are still exposed to POP contamination although they had their use forbidden in that country and corroborate the maternal transfer to the eggs.

*MONITORING CHEMICAL EXPOSURE AND EFFECT USING CELL-BASED BIOASSAYS

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Chemical contaminants have been found in sea turtles all over the world, however, there is a considerable lack of information about the impacts of chemical pollution on sea turtles. Chemical analyses can provide important information about what chemicals are present and at what concentrations. However, sea turtles are exposed to thousands of organic contaminants like pesticides, industrial chemicals, and pharmaceuticals, and chemical analysis may never detect them all. Furthermore, chemical analysis provides little information about the effects of these chemicals. Traditional toxicological approaches to assess the effects of chemical contaminants rely on whole organism, or *in vivo*, exposure experiments, however, these have significant ethical and logistical constraints in large, long-lived, and threatened species

like sea turtles. Cell-based techniques have been increasingly applied to sea turtles to better assess the effects of contaminants in these species. By extracting contaminants from turtle blood and testing the toxicity of extracts in sea turtle cells, cell-based techniques can be used to assess the effects of environmentally relevant mixtures of contaminants to which turtles are exposed. This study used species-specific cell-based methods to assess differences in chemical exposure and effect through time, between different foraging grounds, between age classes and between green and loggerhead turtles in Queensland, Australia. Organic contaminants were extracted from the blood of foraging green or loggerhead turtles using a non-targeted extraction called QuEChERS (quick, easy, cheap, effective, rugged, and safe). Species-specific cell cultures were exposed to the extracts to assess toxicity of environmentally relevant concentrations and mixtures. Increases in chemical exposure were detected over time, differences in chemical exposure between foraging locations were detected, differences in exposure between new recruits and sub adult turtles were detected, and differences in exposure between green and loggerhead turtles were detected. Importantly, these results also include a measure of effect, providing more information than chemical analysis alone. These results demonstrate this technique can be applied to regular monitoring of chemical contaminants, as well as to broadscale ecological questions about chemical exposure and effect.

QUANTIFICATION OF MYOGLOBIN EXPRESSION IN GREEN SEA TURTLE (*CHELONIA MYDAS*) MUSCLE TISSUE

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Sea turtles are highly migratory, diving organisms that travel thousands of miles within their lifetime and stay underwater for hours without breathing. To better understand the metabolic processes involved with long migrations and extended diving periods, this study aims to measure myoglobin content in juvenile sea turtles as a proxy to study aerobic capacity in these organisms. Myoglobin is a respiratory pigment that aids in oxygen transport and storage by facilitating diffusion of oxygen from the blood into the cells where it may be used for cellular respiration in the mitochondria. Previous research has provided estimates of myoglobin content in skeletal muscle of leatherback and loggerhead sea turtles, but there are no published reports of myoglobin content in muscle for other sea turtle species. In this study, myoglobin concentration was assessed in pectoral skeletal muscle and ventricular cardiac muscle samples from six juvenile green sea turtles (*Chelonia mydas*) and one juvenile Kemp's ridley (*Lepidochelys kempii*). Tissue samples were collected from stranded, cold-stunned sea turtles and stored at -80°C for approximately 8 months prior to analyses. An assay adapted from Reynafarje (1962) and spectrophotometry were used to determine myoglobin content in each tissue sample. We hypothesize that myoglobin content will be greater in cardiac muscle than skeletal muscle. The data collected from this experiment will provide insight into physiological adjustments made for hypoxia during diving and the aerobic capacity of highly migratory reptiles.

A METHOD FOR THE COLLECTION OF EARLY-STAGE SEA TURTLE EMBRYOS

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Early-stage turtle embryos, immediately after oviposition, are very small (<5 mm diameter), hindering research on embryonic development at such early stages. Assessing whether turtle eggs have been fertilized and contained a viable embryo at oviposition, especially under field conditions, is complicated by the microscopic size of embryos that have died at an early stage of development. Further, little is known about the molecular pathways that promote and regulate early developmental processes in turtles. Indeed, there are some processes that are apparently unique to this taxon, such as pre-ovipositional embryonic arrest. To enable further analysis of these and other processes critical to early embryonic development in turtle species, a reliable method for extraction of early-stage embryos from the egg is required. Therefore, our aim was to develop a novel and reproducible method for extracting early-stage sea turtle embryos. Herein, we describe the technique for extracting Chelonia mydas embryos before and after white spot formation. Once the embryos were collected, the total RNA of 10 embryos was extracted to validate the method. Total RNA concentration was above 5 ng µl-1 and the RNA Integrity Number (RIN) varied between 7.0 - 10.0; which is considered acceptable quality for further RNA-sequencing analyses. This technique could be employed when investigating fertilization rates of turtle nests and for further investigation of the molecular biology of embryonic development in turtles. Furthermore, the technique should be adaptable to other turtle species or any oviparous species with similar eggs.

PHOTO-IDENTIFICATION AND GEOMETRIC MORPHOMETRICS OF THE PLASTRON FOR THE IDENTIFICATION OF HATCHLINGS-JUVENILES OF THE MARINE TURTLE *CARETTA CARETTA*

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The photo-identification as well as the geometric morphometrics have been employed to study the ecological, behavioral and ontological attributes of several organisms, despite each technique has its own fundaments and applications. The former is based on the individual identification of animals through the photography of their specific traits; while the latter, analyzes statistically and geometrically either the shape of the specimens or their structures due to the many processes that could lead to morphological differences in a certain group of individuals. In the study, the assessment of the viability of the quantity and the shape of some scales of the plastron as traits for the photo-identification of some *Caretta caretta* hatchlings, which came from the XI raising phase of the Program of Conservation of Marine Turtles and Mammals -ProCTMM-, was carry out through the segregation percentage and the recognition percentage by some observers, as well as the morphological stability throughout six months of study. The 81 turtles of 2-year-old, were divided into 29 morphological groups of the 81 expected (general segregation percentage of 35.80%) of which were mostly composed by one or two turtles, highlighting that despite there was a morphological variation among their plastrons, it was not enough to prevent the identification to an individual level, when considering the number of axillar, inframarginal, internal and intergular scales. However, according to the recognition percentage, the variable quantity of those scales between each specimen, as well as their shape, allowed the observers to identify individuals with a 80.01% of certainty when applying the photo-identification system proposed. On the other hand, the statistical analyses of the shape of the axillar and pectoral scales supported a low morphological variation of those traits, leading to an unchanging-structures conclusion, even though there was an exception in three groups. These findings might allow inferring that the conformation, quantity, and shape of the plastral scales were useful when identifying specimens of the loggerhead turtle due to their particularity and morphological stability. It was demonstrated with the newly complementary use of geometric morphometrics for the validation of photo-identification methods.

VARIATION OF CARAPACE SHAPE WITHIN THE SAME NEST?: A CASE STUDY OF *LEPIDOCHELYS OLIVACEA* IN MÉXICO

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Sea turtles depend on specific conditions to ensure the successful incubation of their eggs and are therefore extremely vulnerable to environmental changes or variations. The incubation temperature is related to the temperature of the substrate, solar radiation, ambient temperature, humidity, and precipitation of the site where the hatchery is located. Some studies suggest that the location of the nests on the beach, the color of the sand, the metabolic heat generated by the developing embryos and failures in cellular communication, are factors that also influence the development of the shell. Also, within the nest, there is a variation in incubation temperatures at different depths, so we would expect this variation to affect the shell shape of the hatchlings. This study evaluated the shape of the shells of *L. olivacea* hatchlings incubated at different depths, from a geometric morphometry approach, in a turtle camp on the coast of Guerrero, Mexico. The recorded depths of the natural nests were considered and according to the average obtained from them, the depths used in this study were obtained. We obtained 266 photographic records and grouped them according to the depth at which the eggs were incubated as well as the average temperature for each position (position 1 - from 31 to 38.7 cm - 31.7 °C, position 2 - from 38.7 to 44 .1 cm – 32.29°C and position 3 - from 44.12 to 50 cm – 31.53 °C), we also differentiate between symmetrical and asymmetrical hatchlings. Our results indicate that the pups present asymmetries more frequently in position 2 (79.22%). The shape of the carapace is different between symmetrical and asymmetrical hatchlings, and it is different according to the depth at which the eggs were incubated, differences are observed: (a) the asymmetry in position 1 is greater in the 3/3 of the carapace (direction head-tail) and in the marginal scutes at the level of the last vertebral scutes, (b) the carapace is less wide in turtles born from position 3, in asymmetrical turtles, compared to position 1 and position 2, and (c) greater variation is observed in the last third of the carapace between symmetrical turtles in position 1 and position 2, in the last two pairs of marginal and supracaudal scutes. Finally, the Procrustes ANOVA showed significant differences between depths and symmetry. In conclusion, the depth at which the eggs are incubated determines the shape of the shell in *Lepidochelys olivacea.*

INFLUENCE OF THE INCUBATION SYSTEM ON THE SCUTES PATTERN AND CARAPACE MORPHOMETRY OF *LEPIDOCHELYS OLIVACEA* HATCHLINGS

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Lepidochelys olivacea is considered one of the smallest species in the Cheloniidae Family and the most abundant in the world. In addition to sex, incubation temperature influences embryo mortality, malformations, incubation time, size, and weight of the hatchlings. Recently, it was identified that the incubation temperature also affects the shape of the turtles and the symmetry in their carapace scutes. Therefore, in this study we evaluated the variation in scutes and carapace shape of *L. olivacea* hatchlings produced in hatcheries with different management, using geometric morphometry. The hatcheries are located in Chiapas (Puerto Arista) and Guerrero (San Luis de la Loma), Mexico, and each one has a

different type of incubation. In Chiapas they use shade nets during the entire incubation period and in Guerrero they do not use shade nets. (Or any other system that offers shade to the nests), so we expect to find variations in some characteristics of the hatchlings. We obtained 275 photographic records of *Lepidochelys olivacea* hatchlings, 138 from the Chiapas camp, of which 67.39% were asymmetric, and 137 from the Guerrero camp, where 61.31% were asymmetric. The geometric morphometry analysis was performed using 43 reference points on the shell, and we identified that there are differences in shell shape between both incubation systems: (a) the asymmetry in the Chiapas camp is greater in the last third of the shell (head-tail direction) and in the marginal scutes at the height of the third vertebral scute, (b) the asymmetry in the Guerrero camp is greater in the second third of the carapace (head-tail direction) and in the marginal scutes at the height from the third and last vertebral shield, c) in asymmetric turtles the carapace is wider in the Guerrero camp compared to hatchlings in the Chiapas camp, and d) in symmetrical tortoises a greater variation is observed in the first and last third of the carapace when comparing between camps. Previous studies have reported that the presence of abnormalities in the shell of turtles has an influence on their survival success, however, there are few studies that address this relationship. In conclusion, the incubation temperature resulting from the management system in the camps influences the number of scutes and the shape of the carapace.

THE EXTREME PLUS SEA TURTLE PROSTHESIS: PROSTHETIC FLIPPER FROM 3D PRINTING

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All sea turtle species are listed at some level of endangerment by the International Union for Conservation of Nature (IUCN) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES I). Sea turtles with amputated limbs have regularly been reported, with amputations due to various causes, such as physical damage from entanglement or boat strikes (i.e., fishnet, rope, propeller), wounds from predators (sharks, humans), or severe infections (i.e., bacterial, viral, fungal). Complications after limb amputations include impaired locomotion and diving ability, and impaired ability to compete for food. Such turtles are also easily attacked by predators. There are many reports [DS(1] of sea turtles stranding as a result of these causes globally. Thus, turtles with amputated limbs often must be kept and fed separately in captivity. However, prosthetic flippers have been developed which enhance conservation efforts and improve sea turtles' quality of life in captivity. "Goody," an endangered olive ridley sea turtle in the waters of Thailand, lost her left flipper four years ago after she was entangled in a fishing net. Veterinarians from the Phuket Marine Biological Center, Department of Marine and Coastal Resources, Thailand, took care of her in captivity. Goody was able to swim only with difficulty using her one right front flipper. The EXTREME PLUS SEA TURTLE PROSTHESIS Project [DS(2] was initiated as a collaboration between the Veterinary Medical Aquatic Animal Research Center of Excellence (VMARCE), the Faculty of Veterinary Science, in collaboration with the Faculty of Engineering at Chulalongkorn University, the Department of Marine and Coastal Resources, Sirindhorn School of

Prosthetics and Orthotics (Mahidol University), Petroleum Authority of Thailand Public Company Limited, and PTT Global Chemical Public Company Limited. The prosthetic flipper was designed using technology from limp prostheses in humans, hydrodynamics, and motion analysis theories. The prosthesis was made of carbon fiber-filled nylon and acrylate derivatives (photo-monomer) and constructed using 3D Printer technology. This prosthesis consists of 3 sections: socket, joint, and flipper. The socket part was created particularly to fit with the individual limb. Silicone was filled inside to act as a support cushion and connected with cable ties. The joint portion was developed to mimic the locomotion of sea turtle swimming. The flipping mechanism was designed with spring and shaft supports. The flipper section was created in relative size and shape to the actual flipper with neutral buoyancy. We ensured that all materials were safe for the animal and its environment. After testing, Goody swam much better and learned to use the two flippers to turn around, dive, and search for food. All researchers in this project continue to work to develop prostheses for other injured sea turtles in the future.

USING PHOTO ID TO DOCUMENT AND MONITOR THE PREVALENCE OF FIBROPAPILLOMA TUMOURS IN A JUVENILE GREEN TURTLE POPULATION

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Olive Ridley Project, Portugal

The Olive Ridley Project (ORP) has been conducting in-water monitoring of the Diani-Chale Marine Reserve (DCMR) in southern Kenya since 2018 to assist local environmental authorities in identifying and mapping high-priority sea turtle conservation areas along DCMR's coral reef and lagoon. ORP's team collects data on sea turtle occurrence, abundance, and distribution incorporating photographic identification (photo ID). Photo ID is a non-invasive, low-cost, citizen-science-friendly approach that allows researchers to obtain discrete information about individuals' locations and health status at a given time, which is essential knowledge for spatial planning and conservation management of endangered species. When visible in identified turtles, external tumors are noted, and the turtle is signaled for FP monitoring. As Photo-ID relies on the facial scale patterns, we carefully search for evidence of corneal tumors and monitor their evolution through time. From July 2018 to December 2022, ORP has recorded 2759 green turtle encounters that resulted in the identification of 464 individuals. External tumours were observed in 48 individuals. The temporal evolution of the tumor’s growth is currently being monitored through subsequent re-sightings, with tumor evolution evaluated for 36 of the individuals resighted, including gain, growth and in some cases, recession. The documentation of the incidence of this disease on sea turtles usually involves the manipulation of captured animals and is quite possibly under-documented in foraging grounds. Tracking the evolution of this disease using photo ID can be a useful non-invasive method to understand its extent in foraging aggregations where turtles can be easily monitored underwater.

GROSS AND QUANTITATIVE COMPARATIVE ANALYSES OF EPIBIOTIC *CHELONIBIA* SPP. BARNACLES SUGGEST SEPARATION OF MORPHOTYPES INDEPENDENT OF HOST

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Genus *Chelonibia* is informally referred to as the "turtle barnacles," and was historically subdivided into three species by both morphological differentiation and host affinity. The thin-shelled, high aspect barnacles that are crab and mollusk specialists were designated *Chelonibia patula*; specimens with deeply ridged tests and basal projections that are commensal with marine mammals of the Order Sirenia were designated *C. manati*; and the smooth, low-aspect barnacles affixed to any of the seven species of sea turtles were designated *C. testudinaria*. Recent attempts to reconcile morphological variation with molecular differentiation have presented conflicting results, and additional data are necessary to resolve the taxonomic relationship and investigate the degree of morphological variation among the *Chelonibia*. In this preliminary study, 11 test and cirral attributes of 75 *C. testudinaria* specimens, 25 *C. manati* specimens, and seven *C. patula* specimens were measured for discriminate function analysis (DFA) to compare the three species. We also conducted scanning electron microscopy (SEM) of the captorial fan for *C. testudinaria* and *C. manati* to assess gross setal differences and acquired measurements of 12 small-scale cirral attributes for inclusion in a separate, two-species DFA. As an addition to the morphological analysis, we investigated the phylogenetic relatedness of the *Chelonibia* genus through genetic analyses using two mtDNA loci: 16s rRNA and a 771-base section of the cytochrome oxidase 1 (COI) gene, as well as one sequence isolated from the nuclear genome (28s rRNA), for a concatenated sequence total of > 1600 bases. We demonstrated significant differences in cirrus length in each of the three terminal cirri in a species-specific pattern, and significant differences in shell conicity and ellipticity among all three species. Results of the three-species DFA resulted in distinct species clusters with 80.6 % of cases classified in accordance with expected species designation. Analysis of SEM images of cirral anatomy did not present gross setal differentiation among the three species, although discriminant analysis of cirral attributes resulted in 94.7 % of original and cross-validated cases classified in their correct species group. Further, we found specimens with morphology and host origins that opposed expectation, presenting evidence against the currently held explanation of host-specific phenotypic plasticity among *C. testudinaria*specimens. Results of our study suggest that sufficient variation exists to separate *Chelonibia testudinaria* into subspecies based on quantitative measures of external attributes rather than the hosts from which barnacles are collected, yet molecular divergence estimates remain inconclusive. Precise categorization and taxonomic classification is essential for communicating science and informing policy to mitigate biodiversity loss, as well as for the conservation of endangered host species through associated epibiota. Therefore, it will be necessary to expand molecular comparisons of *Chelonibia* barnacles to arrive at conclusive host-specific, geographic, or environmental subspecies epithets. Alternately, there may be evidence of genetic markers that indicate prior assimilation, introgression, or hybridization of formerly disparate or currently separating species.

*INFLUENCE OF PLASTICIZER ON THE GREEN TURTLE MICROBIOME

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The green turtle (*Chelonia mydas*) is one of the mostly megafauna species affected by the ingestion of solid waste, such as plastic, making it more susceptible to contamination by toxic plasticizers compounds. The microbiome is directly related to the animal's health's condition, including their immune responses. Therefore, this work is a preliminary analysis to understand the effect of the plasticizer diethylphthalate (DEP) on the response of bacterial isolates belonging to the cloacal microbiome of *C. mydas*. The analyses conducted tested tolerance, biodegradation, and production of extracellular polymeric substance (EPS, biofilm-forming molecule), to concentrations of 0.5 mg/mL, 1 mg/mL, and 5 mg/mL of DEP. The microorganisms were isolated from two green turtles of Southern Brazil, one of them intentionally captured (collection B; license SISBIO 43.443/IAP 053/2018) and other from the rehabilitation center, which had defecated plastic (collection E; - the positive control to plastic contact). The isolates showed potential for tolerance to the plasticizer; however, tolerance tended to decrease significantly ($p>0.05$) in proportion to the increase in DEP concentration. Thus, higher concentrations of the plasticizer can be toxic to the growth of microorganisms and the collection B appears to be more tolerance than collection E ($p<0,05$). This result can be related to the phenotypic plasticity of bacteria and a strategy to survive rapid and unpredictable environmental changes. Moreover, the isolates were randomly grouped during the test of the degradation and EPS production. The collection B did show degradation, yet the collection E significantly degraded treatments at all concentrations (0,5 mg/ml: 20,06%;1mg/ml: 27,45; 5 mg/ml: 28,79% to degradation of DEP). In addition, it produced more EPS than collection B for the 1mg/ml and 5mg/ml concentrations ($p<0,05$). Treatments with higher degradation rates showed higher EPS production, that increased in response to the toxicity induced by the plasticizer. Cell aggregation through EPS offers greater environmental stability, in addition to chemical communication via quorum sensing, related to the ability to tolerate and degrade toxic compounds. Biodegradation is a process that requires the action of specific genes, previously selected by environmental pressure., and high concentrations of toxic compounds can cause strong selection pressure on a bacterial community in different ways. Quantitative alterations and changes in the composition of the microbiota due to plasticizer exposure can lead to intestinal microbial dysbiosis, influencing the disorders of the immune, endocrine and nervous systems, which can be critical triggers to the development of diseases. The preliminary results highlight the importance of increasing efforts to describe the green turtle microbiome and understand the anthropogenic factors that affect this composition. Additionally, the results will be crucial to monitoring individuals' health conditions exposed to marine litter.

PERSISTENT ORGANIC POLLUTANTS AND STABLE ISOTOPES IN THE LIVER OF *CHELONIA MYDAS* STRANDED ON THE SOUTHEASTERN BRAZILIAN COAST

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Marine pollution is one of the threats that direct or indirectly cause the reduction of sea turtle populations around the world. Among the various chemical pollutants that are released, there are the persistent organic pollutants (POPs), such as organochlorine pesticides, Polychlorinated Biphenyls (PCBs) and Polybrominated Diphenyl Ethers (PBDEs). They are persistent compounds with high molecular weight, high lipophilicity and high toxicity that can bioaccumulate and biomagnify along the food chain. The green

turtle (*Chelonia mydas*) is a circumglobally species found in tropical and subtropical waters and it is one of the five species of sea turtles that occur in Brazil and it is classified as "endangered" by the IUCN Red List. The aim of this study is to evaluate POPs in the tissue samples of *Chelonia mydas*. Furthermore, the concentrations were correlated with carbon and nitrogen isotopic ratio, biometrics, and ecological factors. Samples were collected from 49 juveniles found on the beaches along the coast of Rio de Janeiro (RJ) and Espírito Santo (ES) in southeastern coast of Brazil. POPs were extracted by Soxhlet using a mix of hexane/dichloromethane and the clean-up was carried out using alumina/silica and gel permeation chromatographic columns. Target compounds were analyzed through the gas chromatography-triple quadrupole mass spectrometry (GC/MS/MS). The concentrations found varied, in ng g^{-1}wet weight, between 2.15 and 103 (RJ) and 2.58 and 83.5 (ES) for total PCBs. The compound ƴ-HCH was the only organochlorine pesticide found and its concentrations varied from <0.4 and 6.54 (RJ) and <0.4 and 7.68 (ES). All PBDEs were found below the limit of quantification (<LOQ). No significant differences were observed between the two regions, which may mean that the main form of pollution occurs through the long-distance transport of these pollutants via the atmosphere and subsequent precipitation. Overall, the concentrations found were low, which may be due to the more herbivorous diet of juveniles of *Chelonia mydas*. There were no significant correlations between pollutant concentrations and isotopic ratios with the size and weight of the turtles, which may be related to the fact that the studied individuals are juveniles and occupy similar trophic positions despite the individual variations found. In spite of the low concentrations, the presence of POPs, mainly PCBs, in the sea turtles' liver indicates their exposure to these compounds. Further studies are needed to understand the exposure and the possible effects over time to which these animals are subject.

THE CENTER FOR REHABILITATION OF INJURED TURTLES IN THE SFAX FACULTY OF SCIENCES: A NEW INSTALLATION TO BOOST SEA TURTLE CONSERVATION IN TUNISIA

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The Gulf of Gabès is an important marine area for sea turtles in the Mediterranean. It is considered, indeed, as an important wintering and feeding area. The anthropic activities that exist in this gulf are considered as threats for these threatened species. In order to mitigate the anthropic impact on marine turtles in the Gulf of Gabès, a center for rehabilitation of injured turtles has been established within the Sfax Faculty of Sciences as part of the Life MedTurtles project, which is co-financed by the EU. Since April 2021, the center has treated forty-one sea turtles, including thirty-seven loggerhead turtles (*Caretta caretta*) and four green turtles (*Chelonia mydas*), of whom thirty-one have been released and returned to the sea after being marked with metal tags. During this time and in order to develop research activities and to better understand the biology, ecology and behaviour of this species, measurements were taken and samples were collected from each sea turtle. As a successful means of educating the various social groups that have visited the center, training sessions on the conservation of marine turtles have been conducted for students, school children, researchers, international volunteers. Greater efforts to improve the conditions in the centre should be made in order to accommodate more sea turtles.

IMPACTS OF A WARMING WORLD: HOW INCUBATION TEMPERATURES RELATE TO BLOOD VALUES AND PRELIMINARY MICROBIOTA FINDINGS IN LEATHERBACK SEA TURTLE HATCHLINGS AND POST HATCHLINGS

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There are seven extant species of sea turtles, all of which are imperiled. As such, large efforts are aimed at understanding the effects of climate change on these animals to aid conservation efforts. Currently, a large knowledge gap exists across hatchling and post hatchling baseline health values and the potential impact of elevated incubation temperatures. Filling these knowledge gaps is critical for these imperiled species, especially leatherbacks. All leatherback populations are considered endangered, but isolated populations of leatherbacks are at higher risk of extinction. The Eastern Pacific population is anticipated to become extinct within the next 100 years. As such, maintaining this population of leatherbacks in temporary human care may be necessary to rescue the population. But to do this successfully, we need to have baseline information, including baseline blood and microbiota parameters. Here we present baseline blood data, preliminary skin microbiota data, and their relation to incubation temperatures in leatherback hatchlings and post hatchlings. In hatchlings we found a mean packed cell volume (PCV) of 24.4 (n = 111) and mean beta globulin value of 0.71 (n=49), while post hatchlings (3-4 weeks) had a mean PCV of 18.9 (n=91) and a mean beta globulin value of 0.65 (n=37). Additionally, we analyzed the effects of incubation temperature on these blood values and found that hatchlings spending more than 50% of incubation time at or above 30°C had higher PCV and beta globulin values. PCV is likely elevated due to dehydration and the increase in beta globulins may indicate inflammation or infection. These alterations suggest that increasing nest temperatures are physiologically straining hatchlings at emergence and possibly prior to emergence. Suboptimal physiologic states at emergence, such as dehydration, inflammation, or infection may negatively impact overall fitness and survival of a hatchling. These data provide initial information to begin assessing hatchling health and possibly elucidate a cause for decreased survival in hatchlings incubated at higher temperatures. Ultimately, these findings can be useful for developing management strategies to mitigate the effects of elevated incubation temperatures in nature.

BLOOD BIOCHEMICAL REFERENCE VALUES FOR NESTING KEMP'S RIDLEY SEA TURTLES (*LEPIDOCHELYS KEMPII*) IN THE RANCHO NUEVO SANCTUARY, MEXICO

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Due to their longevity and physiological attributes, Sea turtles can provide information on environmental changes, for which they are considered indicator species of ecosystem health; since these organisms are susceptible to pathogens such as bacteria, fungi, parasites, and viruses, and in turn, spread diseases by being in contact with other populations or species. Therefore, it is important to implement a population health assessment program to identify diseases and anomalies in individuals and incorporate morphometric data and a physical diagnosis. To contribute to the protection of sea turtles through indicators that allow evaluating and monitoring the health status of their populations, the main objective of this study was to establish the reference values for blood biochemistry of the Kemp's ridley sea turtle (*Lepidochelys kempii*), endemic of the Gulf of Mexico and considered the most endangered sea turtle. The captured turtles presented an average size of SCL=60.39±2.86 and CCL=64.97±3.56. The above corresponds to sizes of a nesting population with new first-nesting recruitments. The sampled individuals presented a good state of apparent health, without the presence of external fibropapillomas, without injured and low or null epibiotic load. It has previously been observed that there are differences between the biochemical values by size and life stages of the *L. kempii* turtle population, however, there are no significant differences by sex with respect to blood parameters, and this is consistent with what has been observed in other species of turtles, populations, and foraging areas, while in nesting areas, there are differences in some parameters as a result of the process of vitellogenesis and nesting of the turtles. The values obtained in this study in the blood of nesting *L. kempii* turtles from Rancho Nuevo, Tamaulipas, Mexico, are similar to those reported in other stages and sex of Kemp's ridley turtles in feeding areas in the Gulf of Mexico; while the parameters that show significant differences (ALB, GLOB, AST, CK y AMYL), they are mainly related to the feeding and capture method, to the loss of energy during the nesting effort, as well as to the fasting state, since the females eat little during mating and nesting (BUN and GLU), or to the process of vitellogenesis and nesting of females (CHOL, TRIG and Ca). By year of capture, there were significant differences in four of the 19 blood parameters analyzed in plasma (GLOB, BUN, AST and AMYL). These variations are a result of feeding as well as the nesting process. Our study is the first to establish blood biochemical parameters of nesting kemp's ridley turtles from RNS, the main nesting area for this critically endangered species. These values can be used as blood reference intervals for a healthy population, and this information will serve as a reference for the health and monitoring of nesting Kemp's ridley turtles.

A CONSERVATIVE APPROACH TO TREATING FLIPPER STRANGULATION INJURIES IN GREEN SEA TURTLES (*CHELONIA MYDAS*) IN HAWAI'I

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Entanglement of sea turtles in fishing gear is a global problem that impacts all species.[1] One of the most frequent causes of morbidity due to fishing gear interaction is front flipper entanglement. Fishing line entanglement causes deep lacerations and strangulation of the affected flipper, leading to significant distal swelling, ischemic necrosis, bone fracture and self amputation. In Hawai'i, a large percentage of green turtle strandings are directly caused by hook and line fishing interactions.[2] Most commonly these present as front flipper entanglement injuries. Historically, these were treated surgically with amputation of the affected flipper at the scapulohumeral joint. Avoiding amputation would be preferred for the individual turtle, the population, and for cost savings. Vascularization of the limb distal to the strangulation injury has been shown to be a key prognostic indicator for potential viability of the flipper.[3] This work led to the development of a conservative approach of rehabilitation therapy to treat affected flippers at the Maui Ocean Center Marine Institute (MOCMI). This approach includes the integration of low level light therapy (laser), massage therapy, and targeted pulsed electromagnetic field (PEMF) therapy. Laser therapy speeds the healing process, promotes tissue regeneration, and relieves pain and inflammation via Photobiomodulation (PBM).[5] Clinically, this alleviates pain, promotes and accelerates wound healing, and resolves inflammation and edema caused from strangulation injuries. Therapeutic massage involves using manual techniques (pushing strokes and manual compressions from distal to proximal) to increase blood and lymph flow to the treated area. As a result, swelling is reduced by removing metabolic wastes and increasing the supply of oxygen and nutrients distal to the strangulation. The Assisi loop is a portable therapeutic device that delivers PEMF to target tissues. PEMF is a micro-current signal that stimulates cellular repair by upregulating endogenous anti-inflammatory molecules. Patient selection criteria for non-surgical conservative therapy included ruling out significant comorbidities and assessing vascular viability via positive doppler flow ultrasound of the brachial, radial, and/or ulnar arteries.[3,4] In the acute inflammatory stage, therapeutic goals were: pain management, reduction in swelling/inflammation, control of infection, and topical wound therapy. In the recovery stage, therapeutic goals were: improve circulation, improve range of motion, build strength and support wound recovery. Daily, patients were removed from the pool for wound therapy followed by multimodal rehabiliation therapy. From 2020 through 2021, 40 sea turtles were admitted to MOCMI for front flipper injuries due to strangulation from fishing gear entanglement. 20 patients underwent surgery for a forelimb amputation, and 20 turtles were treated with the non invasive multimodal integrative rehabilitation therapy protocol. All 40 turtles were successfully released into the wild. Long-term post-release survival information is pending.

VETERINARY ASSISTANCE IN THE MONITORING OF SEA TURTLE STRANDINGS AND STUDY OF TOXIC ELEMENTS IN TISSUES OF LOGGERHEAD TURTLES STRANDED ALONG THE COASTS OF THE CANARY ISLANDS

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Sea turtles, due to their longevity and extensive migratory ranges, are able to accumulate various pollutants over many years and therefore represent interesting bioindicator species of marine ecosystem pollution. It is recognized that frequent exposure to these compounds leads to significant damage to the health of living beings and currently the harmful effect of these compounds is among the top twenty research topics for the conservation of sea turtles and by experts in the field of turtle toxicology. Due to the above mentioned problems, in the present work entitled *"Veterinary assistance in the monitoring of sea turtle strandings and study of toxic elements in tissues of loggerhead turtles stranded along the coasts of the Canary island"*, concentrations of eighty-one toxic elements (trace elements, heavy metals, rare earth and other potentially toxic elements, persistent organic compounds, medicines and conventional pesticides) were analyzed using inductively coupled plasma mass spectrometry in blood and liver tissue samples in seventy-four young sea turtles of the species of *Caretta caretta*. It is important to note that two main study populations were included in this research: captive turtles, belonging to the *Macaronesia Loggerhead Turtle (Caretta caretta) Breeding Habitat Expansion Programme*, resident in Fuerteventura and Gran Canaria islands; and wild sea turtles that are recovering in the rehabilitation centres of these Canary Islands. Among the results derived from the analyses, a different contamination profile between the two islands and study groups can be highlighted. 1) Practically 100% of the samples showed quantifiable levels of potentially toxic elements, such as arsenic, cadmium, mercury and lead, 2) Another significant finding was the presence of rare earth and minority elements in the study populations, such as vanadium which confirms the detection of these elements in biological samples due to current technological development 3) In relation to organic compounds, this study represents the first assessment of the presence of organic contaminants in captive loggerhead sea turtles in the Canary Islands. It is worth mentioning the high frequency of detection of organochlorine substances, including the different polychlorinated biphenyl compounds (PCBs) and especially DDE. 4)Traces of drugs are observed in all groups of animals studied with the highest concentrations in wild turtles. However, it is important to highlight the presence of antibiotic and anti-inflammatory residues in captive animals. 5) Furthermore, different types of conventional pesticides are detected in all sample groups studied, demonstrating the ecotoxicological importance of these substances as they are released into the environment and accumulate in aquifers. In conclusion, the present study contributes to the detailed knowledge of the threat factor that these pollutants represent for the fauna, conservation and marine biodiversity in waters of the Canary Islands archipelago. It should be pointed out that the selection of captive specimens is an essential tool for determining the potential effect of anthropogenic pollutants on these turtles, as the existing scientific literature is scarce in this regard, and therefore constitutes a valuable database for future studies with animals kept in the same conditions.

WHY ARE CONCENTRATIONS OF ORGANIC CONTAMINANTS (PAHS) IN SEA TURTLE TISSUES LOW DESPITE EXPOSURE? THE ANSWER LIES IN THE EFFICIENT METABOLIZATION OF THESE COMPOUNDS

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Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous contaminants which may bioaccumulate through the food webs and affect the biology of a variety of resident and migratory species, including sea turtles. Populations of green sea turtles (*Chelonia mydas*) are distributed through the world's tropical and subtropical oceans and face serious anthropogenic threats including environmental pollution. Following uptake of PAHs by sea turtles, they are readily metabolized by hepatic biotransformation enzymes. Consequently, the concentration of PAHs in the biological tissues of sea turtles is, in general, low or undetectable, resulting in a gap of knowledge on how PAHs are mobilized between tissues for metabolism and excretion. In this work, PAHs were determined in 1485 tissue samples (977 of liver and 508 of fatty tissue) extracted from 1008 individuals (82% females, 22% males; 99% juveniles) of *C. mydas* stranded on the southern Brazilian coast, from Santa Catarina State to Rio de Janeiro State. The site is susceptible to the environmental impacts of oil exploration and production and its derivatives, in addition to vessel traffic in the region as a result of the presence of ports. PAHs were detected in 23% of the liver samples (ΣPAHs: <0,6 to 6405 ng g^{-1} ww) and in 32% of the fatty samples (ΣPAHs: <0,6 to 791 ng g^{-1} ww). A trend towards a higher incidence and higher concentration of PAHs was observed in individuals with better body scores, in both tissues. Considering that the main route of absorption of PAHs is through food, the incidence and concentration of these compounds tends to decrease during the weight loss phase of the animals, given their ability to metabolize and excrete them. As result, the worse the body score, the lower the incidence and lower the concentration of HPA in the animals. This finding helps to understand the low concentrations of PAHs in tissues of sea turtles, indicating that despite exposure to these compounds, they are not detected in tissues of stranded animals due to the metabolization process, and not because there was no exposure to PAHs. Thus, the correlation of PAH concentrations in turtle tissues with other indicators of animal health can lead to misinterpretations.

*OCCURRENCE OF FIBROPAPILLOMATOSIS IN GREEN TURTLES (*CHELONIA MYDAS*) IN RELATION TO ENVIRONMENTAL CHANGES IN COASTAL ECOSYSTEMS IN TEXAS AND FLORIDA: A RETROSPECTIVE STUDY

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Fibropapillomatosis is a neoplastic disease of marine turtles, with green turtles (*Chelonia mydas*) being the most affected species. Fibropapillomatosis causes debilitating tumor growths on soft tissues and internal organs, often with lethal consequences. Disease incidence has been increasing in the last few decades and the reason is still uncertain. The potential viral infectious agent of Fibropapillomatosis, chelonid herpesvirus 5, has been co-evolving with its sea turtle host for millions of years and no major mutation linked with increased disease occurrence has been detected. Hence, frequent outbreaks in recent decades are likely attributable to external drivers such as large-scale anthropogenic changes in the green turtle

coastal marine ecosystem. This study found that variations in sea surface temperature, salinity, and nutrient effluent discharge from nearby rivers were correlated with an increased incidence of the disease, substantiating that these may be among the significant environmental drivers impacting Fibropapillomatosis prevalence. This study offers data and insight on the need to establish a baseline of environmental factors which may drive Fibropapillomatosis and its clinical exacerbation. We highlight the multifactorial nature of this disease and support the inclusion of interdisciplinary work in future Fibropapillomatosis research efforts.

REPORT OF STRANDINGS AND NUTRITIONAL MANAGEMENT OF LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) HATCHLINGS IN THE COASTAL REGION UNDER THE INFLUENCE OF THE SANTOS BASIN, STATE OF SÃO PAULO

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Loggerhead sea turtles (*Caretta caretta*) are globally distributed throughout the subtropical and temperate regions of the Mediterranean Sea and the Pacific, Indian and Atlantic Oceans. The young remain in oceanic habitat, while juveniles and adults prefer neritic zones, being currently considered a vulnerable species according to the International Union for Conservation of Nature's (IUCN) criteria. The present study aims to report the stranding of young individuals of the specie *Caretta caretta* and a proper nutritional management for a subsequent rehabilitation process. Data collected between August/2015 and November/2022 in the state of São Paulo were analyzed, in addition to the clinical records of patients treated at the Gremar Institute through the Santos Basin Beach Monitoring Project, a condition of the federal environmental licensing of Petrobras' activities in the production and flow of oil and natural gas, carried out by IBAMA and with public data available in the Aquatic Biota Monitoring Information System (SIMBA). During this period, five live young were rescued, as follows: one in Ilha Comprida city in 2016, one in Mongaguá city in 2016, one in Itanhaém city in 2022 and two in Guarujá city in 2021 and 2022. Two of these patients died during treatment: from Ilha Comprida, with 23 days in rehabilitation and the patient from Itanhaém, about 20 days after its stranding. Three animals with clinical suspicion of trauma and interaction with marine debris were treated by the Gremar Institute team. The patient from Mongaguá weighed 0.350 kg on admission and was released with 4,900 kg, remained in intensive care rehabilitation for 277 days. The Guarujá young seaturtle (2021) was rescued with 0.295 kg and was released with 4.505 kg; his average growth was 0.42 cm in curvilinear carapace length (CCC) and 0.52 cm in total length (TC) per week during rehabilitation and remained 295 days in treatment until his release. Both releases took place at the Parque Estadual Marinho Laje de Santos, place of interest for biodiversity conservation and preservation. Nutritional management begins with the administration of thin blended sardine (*Sardinella brasiliensis*), where the amount of food is initially calculated at 0.5% of body weight with a gradual increase until reaching 5%, with vitamin supplementation and a variety of fish, according of diet preference (sardines, manjuba, squid, shrimp, crustaceans) and after a few days, patients start free feeding. During the animal's treatment, intensive physical therapy sessions are carried out for muscle strengthening in a high-level tank with brackish water and a controlled temperature of 24-26 ºC. When the specimen reaches the minimum of 30,0 cm of CCC and validation of exams compatible with healthy animals of its species, the animal becomes able to return to its natural habitat.

INGESTION OF A GOLDSPOTTED EEL (MYRICHTHYS OCELLATUS) AS THE POSSIBLE CAUSE OF DEATH IN TWO LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) STRANDED IN THE NORTHEAST OF BRAZIL - NECROPSY FINDINGS

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The loggerhead turtle (*Caretta caretta*) is the most abundant nester of all five species along the Brazilian mainland coast. During the 1980s and the following decades, efforts to protect from human exploitation have been taken and the population has increased. However, the conservation status of the Brazilian loggerhead is less well known than other stocks resident in north Atlantic and Mediterranean waters. Associação de Proteção e Conservação Ambiental Cabo de São Roque is a non-governmental organization that monitors reproduction of sea turtles and is part of a stranding networking conservation initiative at Maxaranguape municipality in the northeast coast of Brazil. Two female loggerhead turtles have been found with signals of detrimental interaction with a goldspotted eel (*Myrichthys ocellatus*) that possibly caused the death of those animals. The monitored area is known for its abundance of hawksbill (*Eretmochelys imbricata*) and Olive ridley (*Lepidochelys olivacea*) turtle nestings. The nesting occurrences of green sea turtles and loggerhead have rarely been reported, with leatherback (*Dermochelys coriacea*) never having been registered. The animals have been found on different dates and the distance among the registers was 5km. The first occurrence was an adult female (CL: 77.1cm; CW: 74.2cm) during the external evaluation of the animal no signs of lesions have been found - that could indicate interaction with fishing nets or boat strikes. In the evaluation of internal organs, a gold spotted eel was found in the coelomic cavity and signs of perforation in the stomach and the liver. This is an indicative to be caused by the bites and movements of this animal, and so, possibly leading to an acute mass hemorrhage and causing the death of the animal. No signs of chronic inflammation have been found. On the second occurrence it was a juvenile (CL: 49cm; CW: 43), also not presenting any external damage or signs of interaction with fisheries. In the coelomic cavity, an encapsulated foreign body ranging from the stomach down to the intestines was found. When the capsule was removed it was confirmed to be a gold spotted eel. As it was an encapsulated foreign body, it has shown a chronicity and indicates that the death was not as acute as the first one. Those reports help to understand different possibilities of the cause of death of stranded animals and show how a necropsy can provide substantial answers even when performed in the field and not at a laboratory facility - with the macroscopic findings.

USING BLOOD PARAMETERS TO PREDICT SUCCESSFUL REHABILITATION THROUGH THE INITIAL WARMING PERIOD IN NEW YORK'S COLD STUNNED KEMP'S RIDLEY SEA TURTLES

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Sea turtles strand on Long Island, NY beaches in the late fall/winter due to cold stunning, a process like hypothermia. The most frequently cold stunned species to strand along the northeast US coastline are juvenile Kemp's ridleys (*Lepidochelys kempii*). These turtles are retrieved by the New York Marine Rescue Center (NYMRC); a non-profit responsible for the rescue, rehabilitation, and release of stranded sea turtles along the NY coastline. Once brought to the facility, turtles are slowly warmed over a period of 5 days, while they are receiving rehabilitative care. This study evaluated the use of incoming (admit) blood parameters to predict potential for successful patient outcomes over the first 5 days of the warming process. Blood samples were drawn and analyzed from 34 Kemp's ridley sea turtles (*Lepidochelys kempii*) over cold stun seasons 2019-2021. Parameters measured from blood samples at intake (Day 1) and when turtles either achieved warming to optimal body temperature (Day 5) or died in house (DIH) were hematocrit (%), white blood cells (thds/cmm), glucose (mg/dL), and potassium (mmol/L). Blood gas data - pO_2 (mmHg), pCO_2 (mmHg), and pH were measured, and all were temperature corrected to the individual's body temperature. Data from turtles that survived warming was plotted separate from those DIH, to reveal measurements that may be used as a predictor of successful warming outcome. Turtles that did not survive the warming process started out with lower hematocrit, glucose, pO2, and pH. These same turtles experienced a decrease in hematocrit, WBC count, glucose, and pH at death, yet also had elevated pCO_2 and potassium, suggesting multiple system imbalances that were unable to be corrected during the warming process. Based on this data, low levels of hematocrit, glucose, pO_2, and pH may be indicators of turtles that will not survive. In this study, potassium levels were not correlated with survival as seen in previous work for Kemp's ridleys, however, a larger sample size may allow for greater statistical power. This research has allowed us to correlate intake blood parameters with warming survival and to continue investigating the physiology of rehabilitation from cold stunning. This project also supports broader local and federal conservation efforts for endangered Kemp's ridleys along the northeastern US coastline.

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*INCUBATION TEMPERATURE, MORPHOLOGY, AND LOGGERHEAD (*CARETTA CARETTA*) SEA TURTLE HATCHLING HYDRODYNAMICS

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Globally, loggerhead sea turtles (*Caretta caretta*) are characterized as endangered by the IUCN Red List and threatened in the United States under the Endangered Species Act. The state of Florida constitutes the largest nesting grounds of this species in the country. Considering current global climate change predictions, sea turtle nests have been forecasted to face many issues including increased incubation temperatures, inundation, and erosion. High incubation temperature can result in many physiological and behavioral changes in hatchlings and may inhibit the physiological traits for efficient swimming. This project examined the effects of incubation temperature on yolk metabolization, body size, swimming kinematics, and blood chemistry to better understand swimming performance in loggerhead hatchlings. It was hypothesized warmer, late-season clutches may exhibit poorer locomotor abilities, impacting their hydrodynamics and energy expenditure. Seventeen nests were sampled across the 2022 South Florida nesting season in Boca Raton, Florida. HOBO U22 temperature loggers were placed in these nests within 12 hours of when they were laid to record nest temperature across the entire incubation period. Upon emergence, 8 hatchlings were retrieved for body measurements and blood testing. Four of these hatchlings were attached to a force transducer to measure forward thrust in a swimming performance trial. Force was recorded continuously throughout the 2-hour trial and each hatchling was manually observed every 20 minutes for total active swim time, breathing frequency, and power stroke frequency. The hatchlings were also filmed at the start and end of their trial to be further examined through a kinematics analysis to examine how buoyancy and thrust impact swimming style. Data suggests hatchlings from nests with higher incubation temperatures tend to be smaller in size and exert less thrust force in their power strokes, thus leading to increased energy exertion when compared to hatchlings of nests with lower incubation temperatures. This study could provide a further understanding of the effect of incubation temperatures on sea turtle hatchling physiology and early survival.

*ASSESSING THE HEALTH IMPACT OF PLASTIC-POLLUTION ON GREEN SEA TURTLES (*CHELONIA MYDAS*) IN ECUADOR, COMPARING THE GALÁPAGOS NATIONAL PARK, MACHALILLA NATIONAL PARK, AND THE MAINLAND

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Marine vertebrates such as sea turtles are at particular risk of plastic-pollution through ingestion or entanglement. Direct consumption of plastic fragments has been observed in all sea turtle species, either through accidental ingestion of particles attached to natural foods or through erroneous direct intake. The green sea turtle (*Chelonia mydas*) is listed as Vulnerable (VU) by the International Union for Conservation of Nature (IUCN) and has been identified as a high-risk species for plastic ingestion and entanglement in recent assessments of the Galápagos Islands. Therefore, we evaluated the potential health impacts of plastic pollution on two islands and a coastal bay in Mainland Ecuador. Health status was determined by hematology, biochemistry, and physical examination. Plastic-pollution was determined by investigating the number and type of microplastics in fecal samples using Fourier transform infrared spectroscopy (FT-IR), in conjunction with polymer concentrations determined by pressurized liquid extraction (PLE) combined with double-shot pyrolysis-mass spectrometry gas chromatography (Pyr-GC/MS). We also evaluated the abundance and composition of plastic-pollution on the coast and in the water through standard methods at our capture locations. In the laboratory, fecal samples were digested using Fenton's reagent, a hydrogen peroxide solution, and ferrous ions. Using the FT-IR imaging system, 175 synthetic particles were found in 33 of the 44 sampled animals (149 fibers, 15 fragments, and 11 films; median of positive samples, 4; maximum, 16). The most contaminated samples were the turtles of Puerto López Bay in mainland Ecuador and Rosa Blanca Bay in San Cristóbal Island Galápagos. The most common types of synthetic particles were (a) polyvinyl alcohol, probably from disposable containers; (b) polyethylene, primarily used for packaging; (c) polyester, probably from clothing or fishing gear; (d) polybutyl acrylate, possibly from paints and coatings; and (e) phenol resin, primarily from electronics. Our study provides a baseline for the eastern Pacific *C. mydas* subpopulation. The health data indicated clinically healthy animals based on standard vital signs, morphometry, and blood values. The lack of an effect on the health

of these animals may be due to the relatively low levels of plastic pollution in sea turtles, their physiology, and the difficulty of isolating plastic pollution from other anthropogenic stressors in wildlife assessments. As plastic pollution continues to grow exponentially worldwide, measuring plastic pollution and wildlife health is fundamental.

HEALTH AND ORGANOCHLORINE PESTICIDES IN NESTING OLIVE RIDLEY TURTLES (*LEPIDOCHELYS OLIVACEA*) AT MAYTO BEACH, CABO CORRIENTES, JALISCO, MEXICO

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Sea turtles are threatened by multiple anthropogenic activities that can affect their health. These activities include the use of organochlorine pesticides (OCPs), which are considered a potential risk to organism health as they can affect the immune systems response and alter cell biochemical processes, which function to produce and synthesize proteins, enzymes, lipids, and glucose. Therefore, the increase or decrease of these parameters, which are considered health indicators and may reflect the impact of OCPs on wildlife organisms. Therefore, we studied the presence of OCPs and their possible effects on health indicator parameters in nesting olive ridley turtles (*Lepidochelys olivacea*) during the 2019-2020 nesting season. To do this, we collected blood from the dorsal cervical sinus and fatty tissue from the neck. The study aimed to 1) evaluate nesting olive ridley health via a physical examination, 2) determine their body condition index (BCI), 3) establish the blood hematological and biochemical parameters, 4) quantify the presence of OCPs present in blood and tissue, and 5) evaluate the interactions between BCI and health parameters with the OCP concentrations found in the blood and tissue of olive ridley turtles. We captured and examined 59 nesting females, of which 35% had minor mating wounds on their necks, 15% presented carapace deformities, 3% had severe carapace damage that had healed, and 59% presented a low epibiont load on their carapace, head and neck with barnacles being the most frequent. Body condition was “very good” in 90% of females and “robust” in the remaining 10%. We observed biochemical and hematological parameter variations, possibly associated with the physiological processes associated with migration and nesting. Samples contained DDTs, Dienes, Chlordane, Hexachlorocyclohexane (HCH), Heptachlor, Endosulfan, and Methoxychlor. The DDTs, Dienes and Endosulfanes in blood presented a positive relationship ($p<0.005$) with eosinophils and uric nitrogen. However, in fatty tissue, DDTs, Dienes, Chlordanos, Heptachlor, HCH, Endosulfan, and Methoxychlor had a positive relationship ($p<0.005$) with eosinophils, total protein, and globulins. That said, DDTs, Heptachlor, Endosulfanes, and Methoxychlor levels in blood presented a negative relationship ($p<0.05$) with hematocrit, total protein, and globulins, while DDTs, Dienes, and HGH in fatty tissue was only negatively correlated ($p<0.005$) to uric nitrogen. This study represents the first assessment of the effects of OCPs in nesting olive ridley turtles and shows that OCPs may affect sea turtle health.

DIRECT TROPHIC TRANSFER OF MICROPLASTICS FROM INVERTEBRATES TO VERTEBRATES ON MARINE ECOSYSTEMS. A CASE STUDIO

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On the 22th of January 2020, a dead leatherback turtle (*Dermochelys coriacea*) was founded floating in front of the Matas Blancas Beah (28.17181, -14.20375), Fuerteventura Island (Canary Islands, Spain), by the staff of a local kite surf school. Protocolised dissection was performed the day after the discover at the Biological Station La Oliva (Fuerteventura, Spain), under authorisation of the local Government (Cabildo of Fuerteventura), responsible of marine fauna strandings in this Island. Researchers of the University of Las Palmas de Gran Canaria, partners of the European Project "Implementation of the Indicator of Marine Litter on Sea Turtles and Biota in RSC and MSFD Areas (INDICIT)", sampled the marine debris ingested by this leatherback turtle following the standardized protocols developed by INDICIT Project. Also, 10% of plastic pieces were analysed by FTIR in order to determinate plastic composition. In other hand, several individuals of the jellyfish *Chrysaora spp*. were founded on the oesophagus, meaning that there were recently ingested. The species identification and the analyses of microplastic ingested by individuals of *Chrysaora spp*. were conducted by the EOMAR team (ULPGC), and micro FTIR analysis of 10% of the microplastics founded were conducted. A total of 101 pieces of litter were founded in the digestive track of the turtle (65 pieces of sheets, 28 pieces of throwlines, 6 pieces of fragments and 2 pieces of other plastics), where the 46.66% were polyethylene, 46.66% were polypropylene and a 6.66% were cellulose. That case demonstrates the direct transfer of microplastics present on the preys to superior trophic levels.

MORPHOLOGICAL AND REPRODUCTIVE VARIATIONS IN LOGGERHEAD TURTLES (*CARETTA CARETTA*) FOUND ASHORE IN SOUTHEAST BRAZIL

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This study aims to explore and correlate biological data of loggerhead turtles (C*aretta caretta*) that were found stranded along the southern coast of São Paulo, Brazil. From 2016 to 2022, during the daily beach surveys (Santos Basin Beach Monitoring Project - PMP/BS) recovered 41 loggerhead turtles (25 males and 16 females) from Iguape (25.3S 48.1W) to Ilha do Cardoso (24.4S 47.1W), a stretch of approximately 140 km. Carcasses found in reasonably fresh condition or animals that died during rehabilitation in Cananéia Research Institute (IPeC) were necropsied. The following body measurements were obtained: curved carapace length (CCL), distance from cloaca to tail (DCT) and distance from plastron to cloaca (DPC). Age estimation was carried out through standardized skeleton chronology for the studied population based on the method used by Snover, 2002; Avens & Snover, 2015 and Coles, 2001. Sexual maturity was assessed following Miller & Limpus (2003) and Pérez-Bermúdez et al (2012). Average body mass was 48.8 kg (range: 30 – 70 kg), average CCL was 75.6 cm (range: 64.6 – 102 cm), average DCT was 4.0 cm (range: 1.9 – 6.5 cm) and average DPC was 16.5 cm (range: 7.9 – 40 cm). Average age was estimated at 13.6 years (range: 10 – 17 years). Nine individuals (1 male and 8 females) were determined to be sexually mature, 30 individuals were immature (22 males and 8 females), and sexual maturity was inconclusive for two individuals (2 males) due to advanced autolysis. A significant difference was noted in CCL according to sexual maturity: immature males had an average CCL of 73.9 cm (range: 94.5 – 58.5 cm) and the only mature male had 88 cm of CCL. Immature females averaged 71.3 cm of CCL (range: 74.2 – 65.5 cm) and mature females 81.4 cm (range: 102 – 74.3 cm). A significant positive correlation was detected between body mass and CCL, body mass and DPC, CCL and DCT, and DCT and DPC. A significant difference was also noted in CCL according to sexual maturity. According to TAMAR Project, loggerhead turtles from Brazil measure up to 136 cm of CCL and 180 kg of body mass, and the average of loggerhead turtles from this study was considerably lower than these upper limits. The lack of a significant difference in morphometric variables of males and females is likely due to the fact that the majority of individuals in this study being immature, therefore not having reached their adult body size where dimorphism is most evident.

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*GEOMETRIC MORPHOMETRY VARIANCES IN THE SKULL OF HARD-SHELL MARINE TURTLES IN THE GULF OF VENEZUELA: IDENTIFYING MULTIPLE POPULATIONS

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The marine turtle skulls have very characteristic morphological features defined mainly by their diet, which could even vary according to their area of distribution and between populations. Also, they may change based on the size class (from juvenile to adult) and the species. In order to assess the relationship between morphological differences of *Chelonia mydas* and *Eretmochelys imbricata* based on geographical origins of their distribution in the Gulf of Venezuela (among Upper Guajira, Middle Guajira, and Lower Guajira), geometric morphometry tools were applied on photos of 83 skulls (n= 69, *C mydas*; n= 14, *E. imbricata*). These photos covered dorsal, ventral, and lateral views. The skulls corresponded to juvenile and adult size individuals of the two species studied. The images obtained were digitized with the TPS Dig 2.30 program. Subsequently, a procrustes superimposition was applied to the landmark data in order to remove any non-shape elements. For the geometric morphometry analysis, we used PAST software; with TPS tool to determine the ontogenetic variation according the size class in each species. We found significant differences in cranial morphology between each of the studied species, mainly linked to their feeding and ontogenetic shifts. In the case of *C. mydas*, a positive allometry was found in the dorsal and lateral view corresponding to the parietal bones. Thus, the growth of this area was faster and greater compared to the rest of the skull, especially with respect to the anterior region, which is characterized of being isometric or with less positive allometry than the posterior area. This corresponds to the feeding habits of this mostly herbivorous species, which anatomically has a short and rounded peak as can be seen in other organisms specialized in aquatic grazing. According to previous research, the greatest development is at the muscular level, especially of the adductor muscles, as well as of the areas of the skull to which they are inserted. In

addition to this, positive allometry also observed towards the posterior area of the ventral region, between the mandibular condyles. For *E. imbricata*, there was also positive allometry in the dorsal and lateral region corresponding to the parietals, also related to greater muscle development. However, negative allometry observed in the prefrontal bones. This slow development of the anterior zone, in addition to the little variation with respect to the juvenile stage, is possibly due to its feeding habits, since it is beneficial to keep a long and narrow peak to access the openings of the coral reefs and obtain the sponges (remarkable food item). This multivariate allometry in the ontogenetic development of both species is the adaptive response according to the energy requirements of each stage. This study provides useful information as a baseline for extensive research on morphological changes that could occur in marine turtles under a wide range of variables.

MICRO-DERMATOGLYPHIC PATTERNS OF SEA TURTLE CARAPACES DO NOT OFFER PHYLOGENETIC INSIGHT NOR EXPLAIN CHARACTERISTIC EPIBIOTIC ASSOCIATIONS

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Micro-dermatoglyphic structure (= fine-scale surface patterning) of turtle scutes was examined from carapace samples from all seven sea turtle species (*Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea*, *Eretmochelys imbricata*, *Lepidochelys kempii*, *L.olivacea*, and *Natator depressus*), one marine terrapin (*Malaclemys terrapin*), one fresh water turtle (*Chrysemys picta*), and one land tortoise (*Chelonoidis carbonaria*), to confirm phylogenetic affiliations and evaluate their involvement in promoting associations with epibionts. Samples were imaged using Scanning Electron Microscopy (SEM) at magnifications between 100X – 20,000X. Initial observations showed that juxtaposed polygons of shell material define turtle scute micro-structure across the Testudines regardless of phylogenetic relationships and ecology. Specifically, turtle carapaces appear to be formed of overlapping polygons on the order of 10 – 30 µm. At finer-resolutions, these polygons are filled with a lattice of pores < 1 µm in size. The only species that did not have these pores was the terrestrial *Chelonoidis carbonaria*. Our conclusion is that sea turtle scute micro-dermatoglyphic structure is conserved across turtle species and age classes. We also demonstrate, for the first time, that leatherback turtles retain the hatchling scale pattern on their epidermis-covered carapace. With this first visualization of scute surface architecture, micro-dermatoglyphic patterns do not appear to be a useful indicator of cheloniid phylogeny nor do they offer insight on mechanisms that might explain species-specific epibiont associations.

MASSIVE DEMISE OF HAWKSBILL SEA TURTLE (*ERETMOCHELYS IMBRICATA*) BLACK SEA TURTLE (*CHELONIA MYDAS AGASSIZZI*) AND OLIVE RIDLEY (*LEPIDOCHELYS OLIVACEA*) IN THE PACIFIC OCEAN OF COSTA RICA AND NICARAGUA

Claudio Quesada-Rodríguez and Oscar Andrés Vargas-Casanova

Ecology Project International

Between August and October 2022, numerous juvenile and adult sea turtles, including Black Sea Turtle, Hawksbill and Olive Ridley, were found dead along the Pacific coastline between Costa Rica and Nicaragua, some of them were found floating on the ocean and others stranded on more than 10 beaches. This is the first time that this event occurred, which led researchers to try to find the reason why these individuals were dying, and a team between local people and scientists got together to better understand the situation. There is not much data about the diet of those species, but the few studies show that Hawksbill Sea Turtles exhibit selectivity for corals, sponges, anemone, and algae, then, it seems that algae, invertebrates, fishes, and seagrasses are the base of the diet from the Black Sea Turtle. It has been described that these three species overlap their feeding area, therefore they will be close to each other while they are looking for food. During special events on the ocean as the “red tide”, that it´s cause by harmful algal blooms, can affect the alive organisms that are on the top of the food chain, researchers have seen that many organisms can be “infected” in a specific area during the feeding process, but then, they can migrate and travel to different places, and subsequently, they could potentially die far away from the place where those species got infected. During August 2022, in the border between Costa Rica and Nicaragua, a place called Conventillos beach (Costa Rica), and La Flor (Nicaragua) turned into a dead place, because dozens sea turtles, mainly Black Sea Turtle (*Chelonia mydas agassizii*), and Hawksbill Sea Turtles (*Eretmochelys imbricata*), were reported as stagnant, most of them dead, according to local people, there were hundreds of individuals, but by the time where researchers visited the place, there were some totally decomposed and there was no way to take any kind of samples to conduct any investigation. An external examination to 100% of the dead sea turtles was conducted on the field, the extremities, head, tail, and carapace were inspected to look for any signs of mutilations by hooks, lures, or fishing nets, but only one of all the sea turtles had a fishing line on the mouth, all the other did not show any external damage. As well, an internal examination was conducted, and nothing related to fishing art was found either.

VISUAL EXAMINATION OF KEMP´S RIDLEY SEA TURTLES ON A NESTING BEACH IN THE NORTH OF VERACRUZ, MEXICO

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During the 2021 and 2022 nesting seasons, 52 adult female Kemp's Ridley turtles (*Lepidochelys kempii*) were visually examined while nesting along 15.5 km of beach in the municipalities of Nautla and Vega de Alatorre, Veracruz. The physical examination consisted of a craniocaudal evaluation to record physical anomalies present on the body; curved carapace length was also obtained. Twenty-seven turtles were recorded in 2021, with a mean length of 66.9 ± 2.3 cm CCL. Turtles were observed between 9:00 and 17:00 h, with an average at 12:30 h. Of the total, 14.8% of the turtles had carapace scars, suggesting some type

of interaction with fisheries. In the 2022 season, 25 turtles were observed, with an average size of 66.5 ± 3.5 cm CCL. Turtles were observed between 6:00 and 18:00 h with an average of 13:20 h. The most prominent physical characteristic was the presence of epibionts in 36% of the specimens; however, one specimen had proliferative lesions suggestive of fibropapillomas. The specimen had six lesions of varying degrees of severity between 1 and 9.6 cm in diameter. The lesions were macroscopically similar to those reported for turtles with fibropapillomatosis, as they were characterized as sessile or pedunculated, cauliflower-shaped or flat plaques. To our knowledge, this is the first case of lesions suggestive of fibropapilloma in this nesting area in Veracruz. Continuing to evaluate the physical condition of nesting turtles will allow us to improve management plans and recognize the threats to this species, which is of utmost importance for its conservation.

CHARACTERIZATION OF UNUSUAL BENTHIC EPIBIOTA OF OVERWINTERING JUVENILE GREEN TURTLES (*CHELONIA MYDAS*) IN URUGUAYAN COASTAL WATERS

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In Uruguay juvenile green turtles (*Chelonia mydas*) can migrate to warm waters or overwinter in coastal waters during cold months, but there is little direct evidence from this last behavior. Since 2001, stranded turtles have been registered during spring with unusual benthic epibionts. Overall, the epibiont species that can contact each turtle is defined by the geographic and ecologic overlays between turtles and the potential epibionts. Therefore, the study of these opportunistic epibionts will allow us to infer the behavior and habitat use of overwintering turtles in the area. In this sense, the objective of this study was to analyze the composition and structure of the opportunistic epibionts assemblages on juvenile green turtles. A total of 120 turtles were sampled at the Karumbé rehabilitation center from January 2019 to February 2020 in Rocha Department, Uruguay. For each turtle, date, location and biometrics parameters were recorded, epibionts were sampled in a 20 x 20 cm quadrat and identified to an initial taxonomic identification. A total of 24 taxa were recorded over the carapace of turtles with massive benthic epibiosis (N=120). Barnacles (*Amphibalanus* sp.) were the most common taxa (n=100, 83%, followed by blue mussels (*Mytilus* spp. n=90, 75%), hydrozoans (*Ectopleura* sp., n=72, 60%) and foliose seaweed (*Ulva* spp., n=59, 49%). Epibiont assemblages found in the carapaces were remarkably similar to mussel beds from shallow subtidal zones. These are areas where green turtles stay during cold months showing that *Mytilus* spp assemblages and its associated biota are good indicators of Uruguayan green turtles habitat use. Previous studies registered similar species of benthic organisms in the study area. All of the taxa recorded as green turtles epibionts were previously recorded in Uruguayan coastal waters associated with consolidated and soft substrates and 19 taxa were previously registered as epibionts. In addition, this work presents the first records of of benthic biota as green turtles epibionts such as the molluscs *Corambe* sp. and *Chaetopleura angulata*, the spider crab *Libinia spinosa*, foliose seaweeds such as *Petalonia fasciata* and filamentosus seaweeds such as *Bryopsis pennata*.

SEA TURTLE EPIBIOSIS: GLOBAL PATTERNS AND KNOWLEDGE GAPS

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Competition for space drives many marine propagules to colonize the external surfaces of other marine organisms, a phenomenon known as epibiosis. Epibiosis appears to be a universal phenomenon among sea turtles and an extensive body of scientific literature exists describing sea turtle-epibiont interactions. When viewed in isolation, however, these epibiont “species lists” provide limited insights into the factors driving patterns in taxonomic diversity on a global scale. We conducted an exhaustive literature review to collate information on sea turtle-epibiont interactions into a global database. As studies involving meio- and micro-epibionts, as well as plants, are limited, we exclusively focused on animal, macro-epibionts (>1 mm). We identified 304 studies that included a combined total of 1,717 sea turtle-epibiont interactions involving 374 unique epibiont taxa from 23 Higher Taxon categories (full Phylum or select phyla differentiated by Subphylum/Class/Subclass). We found that loggerhead turtles hosted the highest taxonomic richness (262 epibiont taxa) and diversity, including representative taxa from 21 Higher Taxon categories, followed by hawksbill, green, olive ridley, leatherback, Kemp’s ridley, and flatback turtles. In addition, the taxonomic richness for all turtle species except leatherbacks was projected to increase with additional studies. We found that taxonomic richness not only varies between species but also between well-studied populations of loggerhead turtles. Lastly, we assessed biases in the current literature and identified knowledge gaps for certain species (e.g., Kemp’s ridleys and flatbacks), life stages (e.g., juveniles), habitats (e.g., oceanic habitats), and geographic regions (e.g., central Pacific, east Atlantic, and east Indian oceans). Our hope is that this database will serve as a foundational platform for future studies investigating global patterns of the diversity, ecological function, and evolutionary origins of sea turtle epibiosis.

EX-SITU CONSERVATION BIASES SEX DETERMINATION AND PROMOTES A BETTER PHENOTYPE IN *LEPIDOCHELYS OLIVACEA* HATCHLINGS

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Relocation of sea turtle eggs to *ex-situ* hatcheries is an effective strategy to mitigate the loss of clutches. Nevertheless, it alters the ontogenesis of the brain and gonads, as well as body size and motor performance at nest emergence. This work evaluated the effect of egg relocation to *ex-situ* nests on the innate response, body condition and survival parameters in *Lepidochelys olivacea* hatchlings. Splenic cytoarchitecture, leukocyte quantification, alkaline phosphatase activity and hemolytic capacity were used as proxies for

immune development. Additionally, the plasma antioxidant-oxidant capacity as well as expression of heat shock proteins (HSP) 70, 90 and Toll-like receptor (TLR) 4 in the spleen and liver were quantified. Body size, sex, sand temperature and survival success (hatching and emergence) were determined. The evaluation was performed with two comparative groups: 19 *ex-situ* nest versus 19 *in-situ* nest. *Ex-situ* nest temperatures favored male differentiation, whereas *in-situ* nest conditions promoted female differentiation. Better body size, splenic development and survival parameters were associated with *ex-situ* conservation. *Ex-situ* relocation did not alter alkaline phosphatase activity, complement lytic capacity or TLR4 expression. However, leukocyte populations, total antioxidant capacity, hydrogen peroxide concentration, as well as expression of HSP70 and 90 showed a differential response. The results suggest that *ex-situ* relocation is associated with a better immune configuration and body condition, as well as a higher survival rate. Although an effect on the basal innate immune response was not observed, the lower antioxidant-oxidant parameters and differential HSP expression support the conclusion that *ex-situ* conditions promoted a better phenotype in newly emerged turtles. Future studies should evaluate the immune response during an infectious challenge.

QARAPARA: NINE YEARS OF HEALTH MONITORING OF BLACK TURTLES (*CHELONIA MYDAS*) OF THE SOUTHERNMOST NATURAL AGGREGATION IN THE EASTERN PACIFIC OCEAN

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Since 2013, the NGO QARAPARA Sea Turtles Chile periodically carries out campaigns to investigate a natural aggregation of black turtles (*Chelonia mydas*) in order to generate scientific information about their ecology and health, as well as their habitat. This aggregation corresponds to the southernmost foraging ground of the southeastern Pacific, and is located in Bahía Salado, Atacama Region, northern Chile (27°41'09.9"S,70°59'31.1"W). The campaigns add up to a total of 17 field trips, with a total of 23 distinct individuals captured (65 recaptures). The captures were made on foot or by kayak by setting a 50x1.8m and mesh size of 35cm entanglement net. All captured individuals were taken measurements, and to those turtles in which blood extraction was possible, it was used for hematology, blood biochemistry and heavy metals analysis. The measurements of the total individuals captured since 2013, varied between 37.5 and 76.5 cm of straight length of carapace and 8.2 and 76.0 kg of weight. Although most of the individuals studied over the years have presented good body condition and hematological values within the reference range, in recent years notorious differences have been found in the results of the biochemical profile, evidencing alterations in the values of glucose, calcium, phosphorus, blood urea nitrogen, alkaline phosphatase, and creatine phosphokinase in some individuals. Seasonal differences have also been found during summer with higher than normal levels of glucose, total protein, albumin, globulins, and blood urea nitrogen. In the same way, the values of heavy metals are altered in relation with the established range for the species, with markedly higher levels for copper (Cu) and lower for lead (Pb) in comparison to previous years. Blood parameters and heavy metals concentrations can fluctuate according to different factors like physiological, natural environment, or pollutants derived from anthropogenic activities. In the particular case of this region there is a presence of mining companies in addition to the nearby transit of vessels and aquaculture activities, which could be increasing the concentrations of heavy metal and altering physiological blood parameters on Bahia Salado sea turtle aggregation. Although most individuals showed a good body condition index, analyses suggest that the availability and/or quality of food resources in the study area has decreased over time. In addition, a marked increase in blood for copper was found compared to previous years, added to an alteration of parameters related to liver and muscle function. All these findings highlight the importance of continuing monitoring pollutants and health parameters of this black turtle aggregation and protecting the area from anthropic activities that may intensify the negative effects on this aggregation.

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*ANNUAL MONITORING OF THE FREQUENCY OF NUCLEAR ABNORMALITIES IN PERIPHERAL BLOOD OF GREEN TURTLE (*CHELONIA MYDAS*) OF QUINTANA ROO: ASSOCIATION OF ENVIRONMENTAL AND BIOLOGICAL FACTORS

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The rapid urban development in Quintana Roo has caused severe ecological and environmental consequences in coastal ecosystems. Physiological sensitivity of green turtles (*Chelonia mydas*) allows to evaluate, through responses of many biomarkers, the degree of alteration by environmental pollution and even possible implications for human health. Nuclear abnormalities (NA) are considered as a biomarker of chronic exposure to chemical compounds that cause chromosome damage. The micronucleus test (MN) is proper for identifying a variety of NA and is considered useful for evaluating environmental genotoxicity in multiple organisms including humans. Our goal was to determine the frequency of NA in erythrocytes of green turtles in four feeding sites with different degrees of environmental disturbances in Quintana Roo (from north to south: Punta Arenas, Akumal, Punta Herrero and Xcalak). Annual differences (period from 2015 to 2019), and between sites, body size and age classes were evaluated. Blood samples were obtained from 165 individuals of *C. mydas* with a body size range of 26.2-111 cm of curved carapace length (CCL). Blood slides in duplicate were stained with a standardized method for sea turtle blood using acridine orange and were observed and photographed by fluorescence light microscope. There were differences in body size of the green turtles between sites ($F_{(3,161)}=81.1$, $p<0.001$); the largest and adults specimens were found in the deepest foraging site Punta Arenas. The 99% of the green turtles presented NA in five years of study. Blebs (97.6%), nuclear buds (97% NBUD), lobed nuclei (88%), eight-shapenuclei (74.7%), notches (63.9%), MN (50.6%), and binucleated cells (3%) were identified and counted in 1000 erythrocytes. The frequency of NA was not correlated with the CCL ($p>0.05$) and there were no differences in the frequency of NA between age classes ($p>0.05$). The frequency of MN, NBUD, and NA was different between zones ($p<0.05$), the highest frequency was found in green turtles from Xcalak, a site with recent urban development. In Akumal, the frequency of MN, NBUD, and NA, increased from 2015 to 2018, and decreased by 2019 ($p<0.05$). Frequency of NBUD, lobed nuclei and notches presented gradual increase from 2015 to 2019 in Punta Herrero and in Xcalak the frequency of MN, eight shaped nuclei, and notches also decreased from 2017 to 2019. The statistical differences between sites and years of capture suggest differences in habitat quality, which could be related to tourist pressure, pollutant concentration, and massive influx of *Sargassum spp*. This long-term study corroborates the lack of correlation between the frequency of NA and body size (age classes), which guarantees the use of the MN test as a biomarker for the green turtle population inhabiting the coast of Quintana Roo.

*MORE THAN JUST ‘FLAPPING’ FLIPPERS: A NEW UNDERSTANDING OF POWERSTROKING IN NEONATE LOGGERHEAD SEA TURTLES

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Among the few long-distance, migrant reptiles, sea turtles are a unique example of movement efficiency. Therefore, it is important to understand their in-water locomotion, especially during poorly studied life stages. Large-scale, active movement is driven by a sea turtle’s large, wing-like flippers via a distinctive swimming gait characterized by simultaneous dorsoventral flapping of both forelimbs, the powerstroke. The powerstroke is efficient in that thrust is generated through most of the stroke unlike in paddling or rowing that has a large, non-thrust producing recovery motion as the limb is repositioned. The flippers and powerstroke are, therefore, advantageous for these migratory animals. We used marker-based X-ray Reconstruction of Moving Morphology (XROMM) to quantify motions of the flipper relative to the humerus and the humerus relative to the pectoral girdle in 5 loggerhead (*Caretta caretta*) neonate sea turtles. XROMM combines X-ray video with CT scans, which are then animated in three dimensions for quantitative analysis. Although the distal parts of the flipper are somewhat flexible, the proximal 1/3 of the flipper remains rigid during powerstroking. Our results demonstrated substantially more long-axis rotation (LAR) of the flipper blade than previously described based upon standard (external view) video. Unexpectedly, humeral LAR contributes significantly to the elevation/depression movements of the flipper due to the abducted posture of the humerus and flexed elbow. The use of XROMM animation revealed these distinctive underlying mechanisms of powerstroking. Just as a conductor does much more than move their arms up and down during a symphony, the captivating choreography of the loggerhead powerstroke is far more enigmatic than the (literal) surface-level “flapping” description typically applied. This better understanding of the intricacies of the powerstroke can aid our discovery of the suite of adaptations that make migration and dispersal during the mysterious “lost years” possible.

*ESTROGENIC HORMONAL PROFILE AND DEMOGRAPHIC PARAMETERS OF THE GREEN TURTLE (*CHELONIA MYDAS*) MEXICAN CARIBBEAN POPULATION

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The hormonal reproductive assessment, including the determination of serum testosterone (T), estradiol (E_2), progesterone (P_4), and total thyroxine (T_4), offers a minimum invasive approach to determining sex, reproductive status, and hormonal reproductive dynamics of chelonians populations. The majority of the ecological studies and sex steroid profiles on sea turtles have focused on nesting females or hatchlings in

nesting areas, resulting in a gap of information about immature individuals of unknown sex in feeding areas, where foragers (juveniles and reproductively active adults) share the same space. The Caribbean Sea in the coast of Quintana Roo provides natural areas for feeding and nesting of four marine turtle species, including the green turtle (*Chelonia mydas*). The goal of this study was to determine serum profile information of steroid hormones (E_2, T) and total thyroxine (T_4) levels of the Mexican Caribbean population of the green turtle, and to provide data about demographic parameters (population structure and sex ratio) required for conservation monitoring. A blood sample and size measurement (curve carapace length, CCL) was taken from 150 free-living green turtles (feeding and nesting) between 2013 and 2019 at seven foraging localities in Quintana Roo coast, Mexico. The sampled population is mainly formed by juveniles (47.33%), subadults (26%), adults (21.33%), and recruits (5.33%) according to Aguirre & Balazs (2000) classification used in Hawaii population. The operational sex ratio in adult foraging green turtles (n=32) was: 3.2:1 (F:M) female-biased. The reproductive stage of green turtles (immature/mature), determined based on the minimal nesting size at Quintana Roo (86 cm CCL), were 79.3% immatures and 20.7% mature green turtles. A new demographic classification based on a bimodal distribution of the CCL is proposed for the Caribbean population, were residents (26.2- 80 cm CCL) correspond to all green turtles found in southern bays (Akumal, Mahahual, Punta Herrero and Xcalak), and transient turtles (66.5- 116.4 cm CCL) are found in oceanic foraging areas of the central and northern region (Xcacel, Ixlache and Punta Arenas). The range of the hormone values match the expected steroid concentration for the species of the same body size. Steroid concentration did not differ between age/size classes proposed for the Hawaiian population, although, Caribbean green turtles showed differences in T concentration between sampled regions ($p< 0.05$) and the new proposed classification (resident vs. transient, $p< 0.05$). Differences in CCL, E_2, T, and T_4 were found between study years ($p< 0.05$), showing a decrease in steroid concentration between years. Our results suggest that T may be used as a demographic marker for this population. The information provided by this study is extremely valuable as a basal data of endocrine dynamics and in the attempt to determine the reproductive status for conservation programs in the area.

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*INTERACTIONS BETWEEN TOXIC ALGAE AND PLASTIC POLLUTION: ADDITIVE THREATS FOR GREEN SEA TURTLES (*CHELONIA MYDAS*)?

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Algal toxins are involved in the mortality and/or illness of marine organisms upon direct exposure to toxic cells or via consumption of contaminated prey. Toxic cells may become abundant in the plankton during harmful algal blooms, but may also colonize distinct substrates such as sediments, seaweeds and seagrass. Furthermore, microalgal cells and their toxic compounds may attach/adsorb onto marine debris, especially plastic litter, thus representing an additional, multi-contaminant stressor for marine organisms. In this study, the presence of potentially toxic microalgae was investigated within the digestive tract contents (DTC) of a threatened species of green turtle (*Chelonia mydas*) found dead-stranded in southern Brazil. Juvenile individuals were sampled in two periods: winter/2015 to autumn/2016 (n=39), and winter-autumn/2022 (n=50), when half of the animals contained copious amounts of plastic debris in their DTC and the other half contained none to negligible plastic amounts. Additionally, the occurrence of lipophilic toxins was determined by LC-MS/MS in tissue samples (liver, stomach and/or intestine) of selected animals (n=37). Thirteen potentially toxic species of microalgae, including seven dinoflagellates, six cyanobacteria and one diatom, were found in the DTC of green turtles. Among them, dinoflagellates were relatively more abundant in winter and cyanobacteria, including Lyngbya cf. aestuarii, in summer. Dinoflagellates belonging to the Dinophysis acuminata species complex were the most frequent (25-30%) and abundant taxon (max. 566 cells g-1). Moreover, 23% of the examined sea turtles exhibited detectable levels of the diarrhetic toxin okadaic acid (OA) in washed digestive tissues. Seven individuals accumulated OA in their intestines (max. 24.1 ng g-1) and two in the stomachs (max. 7.4 ng g-1). Toxin levels in the tissues were significantly ($r=0.70$, $p<0.025$) and directly associated with the cell abundance of OA-producing D. acuminata and Prorocentrum lima species complexes within the DTC of green turtles. Although OA concentrations were relatively low, possible chronic exposure might deteriorate general health conditions of exposed sea turtles and increase the risk for diseases. Okadaic acid has been considered a tumor-promoting compound and an environmental co-factor in the incidence of fibropapillomatosis, a frequent disease in juvenile green turtles inhabiting this geographic region. Even though, only one green turtle containing OA in the digestive tissues (out of six examined) also presented fibropapillomatosis in this study. Regarding the interaction with plastics, preliminary results (DTC samples from 10 stomachs) indicated greater ($p=0.01$) abundances of cyanobacteria in green turtles with virtually no plastic litter in their digestive tracts compared to those that had ingested plastics (101±30 vs. 1.3±0.75 colonies g-1, respectively). Although at low abundance, cells of the toxic dinoflagellates D. acuminata and Ostreopsis cf. ovata were apparently more frequent in green turtles lacking plastic debris, but this has to be confirmed in the remaining samples from the stomach and intestines. Sea turtles are sentinels of ocean health. Monitoring the accumulation of algal toxins and their negative effects on these organisms might therefore support more effective management actions to conserve biodiversity and marine habitats.

TRACE ELEMENTS CONCENTRATION IN BLOOD OF NESTING KEMP'S RIDLEY TURTLES (*LEPIDOCHELYS KEMPII*) AT RANCHO NUEVO SANCTUARY, TAMAULIPAS, MEXICO

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Trace elements, especially toxic elements can harm the health of organisms, they are of great interest for ecotoxicology since the entire food web can be affected, mainly top organisms. The Kemp's ridley turtle (*Lepidochelys kempii*) is an endemic species of the Gulf of Mexico with a single population worldwide, and it is considered the most endangered species because 90% of its clutches occur on a single beach and this region is associated with oil activities and the discharge of pollutants through rivers and runoff. Therefore, it is a priority to analyze the concentration of trace elements in the blood of the nesting turtle *L. kempii* from the Gulf of Mexico. This information will allow to establish the basal values of the species in its main nesting area, expand knowledge regarding the bioaccumulation process and evaluate the possibility of considering it as a "sentinel" species in the Gulf of Mexico. During the nesting season of the 2018-2020 periods, 83 nesting samples of *L. kempii* were collected in Rancho Nuevo, Tamaulipas, Mexico, 26 in 2018, 28 in 2019 and 29 in 2020. The individuals were apparently healthy, without the presence of external fibropapillomas, without injuries and low or no epibiontic load. The specimens in general presented a straight carapace length (SCL) mean of 60.78±0.30 cm. The sequential concentrations of trace elements in

Kemp´s ridleys blood were Zn>Se>Cu>As>Pb, while Hg and Cd were not detected. The mean concentrations (µg g^{-1} wet weight) of Zn, Se, Cu, As and Pb were 0.79, 0.14, 0.09, 0.08 and 0.06 respectively. The levels of trace elements were lower than those reported in other studies, which ecologically represents a low availability of these elements. Previous studies report that essential elements decrease during the sea turtle nesting season due to maternal transfer and vary depending on the region and size of the individuals, as well as the habits of the species. The values of trace elements in the blood of the *L. kempii* turtle obtained in this study can be considered as common for this species, consistent with the low bioavailability of metals that is observed in the trophic web of the Gulf of Mexico.

CONSERVATION, MANAGEMENT AND POLICY

SEA TURTLE CONSERVATION AND MANAGEMENT PLAN IN THE DEPARTMENT OF MAGDALENA, MAGDALENA

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A conservation and management plan can be defined as a biodiversity management tool that must contain certain guidelines and necessary actions for the protection of the species that may be categorized under some degree of threat, furthermore, with the planning of lines of action for the preservation of the populations in different ecosystems. The structuring of a Management and Conservation Plan for Sea Turtles in the department of Magdalena was carried out, considering the following aspects: 1) Geographical scope of the plan in which the description of the area of coverage and impact is included, 2) Characteristics of the species to be conserved taking into account the biological and ecological descriptions of the species present in the Magdalena, 3) Conservation status and threats of the target species, mentioning the categorizations of their current status, red lists and listing of species protected by CITES, 4) State of knowledge of local communities and their perception of the target species, highlighting key actors such as artisanal fishermen, diving schools and tourism service providers. 5) Legal framework, which covers the legal context of the species. 6) Lines of action describing the activities to be carried out for the conservation of sea turtles for the department of Magdalena, with a focus on scientific research, environmental education, current legislation, anthropic impact, institutional management, information and disclosure. 7) Prioritization and financing of programs and projects in order to meet the objectives and design the activities established. This was done through an inter-institutional alliance between the Magdalena Regional Autonomous Corporation-CORPAMAG, the Turtle and Marine Mammal Conservation Program-ProCTMM, the CIM Caribbean Foundation, Sila Kangama Foundation and Petrobras.

*IN-DEPTH BIOECOLOGICAL AND CONSERVATION ASSESSMENT OF *CHELONIA MYDAS* IN THE GULF OF VENEZUELA

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Green turtles (*Chelonia mydas*) are conservation dependent in many areas of the world. They require management strategies for effective conservation that include multiple approaches that recognise the spatial and ecological scales for the species. Hence, evaluating and quantifying the take frequency and bioecological aspects of the green turtle is crucial to develop a co-management strategy, especially in areas where this species is heavily used. Thus, this research aims to characterise the frequency, size variation, and geographical distribution among decades of green turtle taken by Wayuu Indigenous People in the Gulf of Venezuela. We compiled stranding events which occurred in the study region between 1987 and 2022 (August) from the NGO Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV) database. These records were recorded using three different sources: 1- Scientific patrols; 2- Community surveys; and 3- Desktop study. From each record we collated: date, location, turtle size (CCL); cause of stranding. We used the CCL to categorise (size class) the individuals. Of the 1,440 green turtles recorded during the study period, 1,089 (76%) were categorised as immature,197 (14%) were adult-sized, and 154 (10%) were not classified. The size of the green turtles registered ranged from 20.1 to 122.2 cm (mean = 58.3 ± 22.6 cm, n= 595). Most of the individuals measured between 60.0 and 79.9 cm of CCL. Our data indicated that there is a year-round presence of green turtles in the area, with peaks of frequency coinciding with the local precipitation (July and November). Hence, during this period the winds are generally calmer, and fishers are able to increase their capture effort. When the CCL were analysed across time, we observed a shift in the modal of size of CCL recorded between 1987 and 2022, and a decline of larger sized turtles after 2007. Although, the presence of green turtles of all size classes co-occurring in the same foraging ground is rare in the Atlantic Ocean, we found first time this co-occurrence (immature and mature-sized individuals) within the same habitat in the Caribbean Basin (Gulf of Venezuela). We found that the green turtle mean size of caught/stranded has reduced over time; however, it could be that in late years the incentive program provided by the GTMM-GV may have increased the rates of smaller turtles. Moreover, some authors suggest that an increasing abundance of small green turtles in the southern Caribbean could be related to positive conservation outcomes being produced by projects in some of the region’s main nesting beach areas (e.g. Yucatan Peninsula, Mexico). Finally, the human related-cause was the first cause of stranding, e.g. intentional take and by-catch. Almost 4,000 green turtles are taken annually in the Guajira Peninsula, most of them by small-scale artisanal fisheries performed by Wayuú Indigenous people, and a similar scenario is occurring in the Colombian portion of the Guajira Peninsula (area populated by Wayuu Indigenous People as well); hence, a binational program is urgently needed.

THE EVOLUTION OF SEA TURTLE CONSERVATION: A LITERATURE PERSPECTIVE

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Mexico is known for its natural heritage that is found both in the terrestrial and aquatic environments. Along its Pacific, Caribbean, and Gulf coasts, six of the seven species of sea turtle can be found nesting, reproducing, feeding, and migrating at different stages of their lives. This gives Mexico the opportunity to have a positive impact in the conservation of sea turtles at different life history stages. However, conservation has been evolving and will continue to evolve as we become more knowledgeable on how ecosystems function and prepare for the effects from anthropogenic pressures. This study focuses on a historical and holistic analysis of sea turtle conservation in Mexico by quantifying conservation effort based on specific conservation strategies. Conservation effort was measured by using systematically selected scientific literature that was published between 1973 and 2018 and the conservation strategies were based of 10 targets that directly impact the success of sea turtle conservation taken from the 2020 Aichi Biodiversity Targets. A comparison of the conservation effort was made between data from 1973–1999 and 2000–2018, representing the beginning of the conservation movement and modern conservation, the ten strategies were categorized by their conservation priority based on their conservation time period. When looking at current conservation priorities the high conservation effort has been in protected areas, extinction prevented, and public awareness. However, not a lot of effort has gone into habitat loss and restoration, sustainable marine management, climate change, and invasive species, which have evolved to being considered a high priority in our present time compared to the beginning of the conservation movement. Almost 30% of the research comes from Baja California Sur and focus on the Olive Ridley and Eastern Pacific Green sea turtles. This analysis allows for identification of knowledge gaps and imbalance of conservation efforts in Mexico. It also gives a better picture of which sea turtle species and locations could benefit from more financial, scientific, and community support in order to improve the survival of sea turtles along the coasts of Mexico.

PLASTIC POLLUTION ON SEA TURTLE NESTING BEACHES ON THE COAST OF MICHOACAN, MEXICO

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Mexico's extensive coastline is made up of more than 11,000 kilometers that represent one of the attractions that Mexico offers to the world. Approximately 70% of the coastline corresponds to the Pacific Ocean, Gulf of California, and Sea of Cortes, while the rest corresponds to the Gulf of Mexico and Caribbean Sea. Sandy beaches are important for tourism development in Mexico; however, tourism and infrastructure on sea turtle nesting beaches represent a threat to nesting habitat, nesting females and hatchlings that emerge and move to the sea. One of the main threats from tourism activities is plastic pollution. In the past, sea turtle populations were decimated by the indiscriminate capture of adults and the plundering of nests. Currently, sea turtle populations are at risk due to the degradation and loss of marine and coastal habitats. For the above reasons, five nesting beaches of black turtles (*Chelonia mydas agassizii*) and leatherback turtles (*Dermochelys coriacea*) were monitored and evaluated. At La Llorona, Colola, Maruata, Arenas blancas and Mexiquillo beaches on the Michoacan coastline, the type of plastic collected during 2017 was

evaluated volumetrically and classified. The results indicate that the beaches with the highest contamination were Mexiquillo (29.3 kg) leatherback nesting site and Colola beach (28. 5 kg) nesting site of the black turtle (*Chelonia mydas agassizii*), while the beach with the least plastic pollution was Arenas Blancas beach with a total weight of 2 kg of plastic, plastic materials such as Polyethylene terephthalate (PET) and High Density Polyethylene (HDPE) presented the highest weight within the type of plastics found and were presented with the highest frequency of occurrence on the beaches sampled.

*A NEW ACTION OF CUBA FOR THE CONSERVATION OF SEA TURTLES: INCINERATION OF STORED SHELLS

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Cuba exported hawksbill shells for many years. When the export of shells was discontinued in 1993, our country presented a "Proposal to change the hawksbill turtle from Appendix I to Appendix II" at COP 10 and 11 (Nairobi 1997 and Harare 2000, respectively), to allow trade in shells accumulated from traditional fishing, but the votes for approval were not reached. However, the country continued to store shells from the fishery, following the control system established by CITES-Cuba. In January 2008, it was decided to close the sea turtle fishery indefinitely as a contribution by the country to the conservation efforts of these species in the region. The total number of shells accumulated until the closure of the fishery was 8.1 tons, which were kept under strict control at the CIP (Fisheries Research Center). Given the impossibility of its use for trade and as a new action in favor of sea turtles, the country decided in 2021 to start the incineration of stored shells as one more contribution to international efforts for the conservation of endangered species.

GROSS-VEGETATION LITTER AND SEA TURTLES NESTING: THE CASE OF BOBALITO NESTING BEACH (COLOMBIAN CARIBBEAN) AND ACTIONS FROM THE CIVIL SOCIETY

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Bobalito is a beach long 8,4 kilometres, located on the southern Caribbean coast of Colombia, within the ecoregion Urabá-Darién. This beach is one of the best conserved coastal environments on the Caribbean coast, with a mature and stable dune ecosystem, where four sea turtle species nest (leatherback, hawksbill, green, and loggerhead). However, thousands of tons of gross-vegetation litter arrived yearly at the beach, affecting sea turtle nesting, especially for leatherbacks due to their large size and weight. This gross vegetation comes from deforested areas in the upper watershed of the Atrato River. Since 2009, Bobalito has been monitored by the local community, until the beginning of 2021 when the environmental authority (Corpourabá) banned entry to the beach with Resolutions 0422/21, 1849/21, and 0289/22. According to the monitoring data recorded until the banning, which was obtained by the first author after a legal inquiry to the environmental authority submitted on 25/11/2021, in the light of article 23 of the Colombian Constitution, 1875 nests were registered between 2010 and 2020 (1138 of *Dermochelys coriacea*, 642 of *Eretmochelys imbricata*, 91 of *Chelonia mydas*, and 4 of *Caretta caretta*). Such as the local community, the civil society organizations have also played an important role since the beginning of the monitoring. In

2009, the first activities were promoted by Fundación Biomunicipios, and during the last 14 years, other organizations have occasionally assisted the community to continue this huge effort. In March 2021 a group of civil society organizations and interested people, supported by the municipality, organized the first (and only until now) Scientific Sea Turtle Camp, with the goal to clean 2 km of gross-vegetation litter and plastic waste. Although the same day that the camp started Corpourabá published the first ban to entry the beach at night, 94 students from 27 cities of Colombia and 35 bachelor's degrees arrived at the beach, with the purpose to move out of the vegetation from the sand; in addition, more than 1200 kg of plastic waste were collected. The impact of this activity on sea turtle nesting was not measured because in 2021 the monitoring stopped, but the message about the urgency to solve this pollution problem was clear and loud. Lastly, in mid-2021 the Network of Civil Society Allies for the Conservation of Bobalito Beach was created with the purpose of supporting and strengthening the local community in their endeavour to recover the sea turtles monitoring activities on the beach. Unfortunately, the efforts from the civil society were inhibited by the second ban to entry the beach, but this presentation is another step to show the world the high-value ecosystem that Bobalito is for the sea turtles in Colombian and the Wider Caribbean, as well as the threat that gross-vegetation litter could be.

OBSERVATIONS ON THE COMMUNITY-BASED CONSERVATION INITIATIVE: MARINE TURTLES AT BOBALITO BEACH, GULF OF URABÁ-DARIÉN, ON THE CARIBBEAN COAST OF COLOMBIA

Amalia María Cano-Castaño[1,2,3], Carlos Puentes[1], Adriana Cifuentes Carvajal[1,4], July Andrea Múnera Castaño[1], and Alejandra Cadavid Perdomo[5]

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Over time, exploitation of marine turtles and their eggs for consumption and trade, led to concerns about the turtles' status. Bobalito Beach, on the Caribbean coast of Colombia, is an important nesting site for *Dermochelys coriacea* and *Eretmochelys imbricata,* with infrequent nesting by *Chelonia mydas* and sporadic nesting by *Caretta caretta*, a species Critically Endangered in Colombia. Thirteen years ago, leaders from Lechugal Village created the community NGO "Environmental Conservation and Ecotourism Association (Acaetur)" to help turtles (Corpourabá, n. d.). From 2010 through 2020, Acaetur was commissioned by Corpourabá—the government environmental authority of the area—to monitor and protect turtles, nests, and hatchlings on the approximately 10 km of Bobalito Beach. During this 11-year period, community records reported 1875 nests: 1138 Leatherback, 642 Hawksbill, 91 Green, and 4 Loggerhead (Corpourabá, 2020). In 2021, we made two visits to Lechugal, coordinating and participating with members of the Village as part of a team. On both visits, informal meetings with local community members, and other stakeholders, provided information on key local players, opportunities to exchange information on turtles, the beach, and crucial social issues, as well as priorities for future collaboration and community outreach and capacitation. During the first visit (while it was still permitted), our team conducted diurnal beach surveys, recording tracks, nests, and egg predation, as well as driftwood and plastic beach contamination. During the second visit, to increase awareness of, and engagement with, conservation issues, our team developed workshops for children from Lechugal and nearby Río Necoclí Village, events that were enthusiastically received. Nighttime surveys were planned, but they were banned in 2021—and subsequently in 2022 and 2023—, because Corpourabá issued resolutions as official measures to close Bobalito, ostensibly to protect it from tourist activities: at first these were nighttime closures, but later they became full closures. The effects of the resolutions were not systematically evaluated, or at least no technical report that accounts for this has been published. This work summarizes observations, perceptions and recommendations in an effort to add to the community-based conservation at Lechugal Village and Bobalito Beach. The importance of this locality for marine turtles, as well as for community and social development in Colombia and the Wider Caribbean encourages us to share this information. It also emphasizes the relevance of the local community as a critical actor for the conservation of turtles and their habitats, as well as community development in the country. It is urgent that Colombian environmental authorities lead by institutionalizing fundamental changes to protection practices, through fully recognizing and supporting a socio-ecosystem approach that relies on realistic alternatives for conservation, management, and social development (Caballero *et al.*, 2016; Pulido, 2020).

TACKLING LIGHT POLLUTION ON SEA TURTLE NESTING BEACHES IN PUERTO RICO

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Puerto Rico is an urbanized Caribbean Island where most of its population and development are on the coast. As an indirect impact of coastal development, the inappropriate or excessive use of artificial light or “light pollution” has become one of the most critical threats for sea turtles in nesting beaches. A threat, that if not addressed can be lethal for these endangered species. In response to public concerns, legislation was approved in 2008 (Law #218 for the Control and Prevention of Light Pollution) that includes specific regulations for properties adjacent to sea turtle nesting beaches. However, enforcement has been lax due to legal ambiguities and a lack of regulatory personnel. In 2020, a beachfront lighting retrofit program funded by the National Fish and Wildlife Foundation was developed as part of the Leatherback Habitat Restoration Project led by the National Wildlife Refuge Association, in collaboration with the Puerto Rico Department of Natural and Environmental Resources (PR-DNER), and several community-based sea turtle conservation groups and. The program pursues a seven-step process which includes a lighting retrofit plan and cost-free luminaries for the eligible property. Since the program's launch, 110 properties in 17 coastal municipalities have participated, including private residences, condominiums, nature reserves, municipal parks, and even commercial properties like hotels, AirBNBs, and restaurants. Even though there is still so much work to be done to guarantee a long-term impact, we can confirm that in comparison with previous years, beaches are darker now. Hopefully, this effort has generated enough empathy and knowledge to change people’s attitudes and behaviors toward sea turtles and the impact of excessive light on nesting beaches. While action and money invested so far have paid off in reducing light pollution at nesting beaches, we hope that these successes can continue and expand. The big question facing our Lighting Retrofit Program is whether the work can be sustained for the long term, something that must be reinforced by the effective enforcement of the law, but also through ongoing efforts in education, awareness campaigns, and local capacity building with help from a variety of sectors ranging from government professionals to local communities and non-profit partners.

*BILLION BABY TURTLES PROGRAM: SUPPORTING COMMUNITY-BASED NESTING BEACHES AROUND THE WORLD

Adriana A. Cortés-Gómez and Brad Nahill

SEE Turtles

SEE Turtles' Billion Baby Turtles program supports turtle nesting beaches around the world through small grants. We focus on community-based and community-oriented projects that both help keep nesting turtles and hatchlings safe from illegal hunting and help provide jobs for local residents to work in sea turtle conservation. This program started in 2013, supporting one project, and over the past decade this program has grown dramatically. In 2022, the program has supported 48 projects: in Costa Rica (12), Mexico (8), Indonesia (8), Panama (3), Puerto Rico (2), Nicaragua (2), Grenada (1), Philippines (1), Jamaica (1), Venezuela (1), Iran (1), El Salvador (1), Sri Lanka (1), Malasya (1), Cabo Verde (1), Papua New Guinea (1), Ghana (1), Ivory Coast (1) and Kenya (1). This brings the total for 2022 to 48 grants totaling more than US $270,000, helping protect an estimated 3 million hatchlings. From these 48 grants, 2 have been for the Emergency Fund program, 2 Survey Grants, 11 new BBT partners and 33 annually (at least for 2 years) supported partners. To date, we have provided more than 150 grants totaling over US $900,000 that has helped to save more than 9 million endangered turtle hatchlings at 50+ beaches in 23 countries and supported salaries for 156 local residents. Funding for this program comes from corporate sponsors, schools, individual donors, and profits from SEE Turtles Conservation tours. In 2021, we began our Sea Turtle Inclusivity Fund to invest in building capacity of local residents, minorities, and underrepresented communities. So far, we have given 9 grants totaling US $15,000 to young researchers in 6 different countries (Costa Rica, Brazil, Panama, Venezuela, Papua New Guinea, and Indonesia).

BLACK SEA TURTLE (*CHELONIA MYDAS AGASSIZII*) IN MICHOACAN: SIGNS OF A RECOVERED POPULATION

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The project for the conservation of the black turtle (*Chelonia mydas agassizii*) population in Michoacan, Mexico, celebrated in 2022, 40 years of systematic conservation activities on the beaches of Colola and Maruata, the main nesting sites for this population on the coast of Michoacán. Despite being one of the most endangered populations in Mexico since the early 1970s, now after four decades of conservation efforts by the indigenous Nahua communities of Colola and Maruata, accompanied by biologists from the University of Michoacan since 1982, the black sea turtle population shows signs of recovery. In the 2021/2022 breeding season, more than 76,000 nestings were registered on Colola beach during the months of August 2021 to April 2022, which represents a little more than 25,000 nesting females. On the other hand, intense nesting activity of female black turtles was registered during the dry months (May, June and July), something particularly unusual in Colola in more than 60 years. Considering the historical nesting area of black sea turtles in Michoacan (+-80 km) from the mouth of the Nexpa River to the Faro de Bucerias, where 10 important black sea turtle nesting beaches are located such as La Llorona, Motin del Oro, Xicuaza, Maruata and Maruata Viejo, Paso de Noria, Cachan de Echeverria, Arenas Blancas and Chocola, we estimate that during this period 30,000 females nested in Michoacán producing approximately 103,000 nests. The number of black sea turtle nesting females and nests produced reached the baseline of 25,000 black sea turtle nesting females estimated for Colola beach in 1965. Considering that the remigratory periods of this population are three years, and the nesting that occurs within the historical nesting range on the Michoacan coast, we can estimate that the black turtle population in Michoacan is approximately 90,000 nesting females. Outside of the historical distribution range of black sea turtles in Michoacan, important nesting has been reported in localities in the states of Nayarit, Jalisco, Guerrero and Oaxaca, which indicates that the recovery of the black turtle population in the Mexican Pacific transcends the borders of Michoacan. The history of the recovery of the black turtle in the Mexican Pacific is the result of the synergy of conservation efforts by national and international organizations, indigenous communities, academics, students and volunteers, who have collaborated in this arduous work for 40 years.

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*STRENGTHEN HAWKSBILL SEA TURTLE CONSERVATION IN THE MEXICAN PACIFIC. WWF MEXICO

Esbaide Eliosa-García[1], Catherine Hart[2], Lourdes Martínez-Estévez[3], Eduardo Nájera-Hillman[1], and Daniel Flores Díaz[1]

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[3]*ProCAT Colombia International*

Hawksbill Sea Turtle (*Eretmochelys imbricata*) is a species that occurs along all the tropical and subtropical coasts of the world's oceans. In Mexico, we find it on the Atlantic and the Pacific coasts, where it feeds on algae, corals, mollusks, crustaceans, other invertebrates and sea sponges, Hawksbill Turtles are listed as critically endangered. The population along the Eastern Pacific, which involves about 539 nesting females, is the most endangered one. Threats towards this species include bycatch, illegal harvest of eggs and meat, habitat destruction, pollution, predation by non-native species, and climate change— as the sand temperature can alter the ratio of male and female hatchlings and egg viability. Since 2015, WWF has pushed forward the conservation of hawksbill turtles through three main topics: Scientific monitoring, support of sea turtle conservation camps, public policy, and communication and environmental education. For the first topic, hand by hand with our scientific partners, the results are a machine learning technology to identify 291 sea turtle individuals and 28 distribution areas, with 952 photos provided by citizen science. Sea turtle camp managers, scuba divers, tourists, researchers, and the general public have participated in this project. WWF also has supported satellite tagging on 11 adult female and male hawksbills to identify key reproduction areas and connectivity between Bahia Banderas, the Gulf of California, and the Islas Marias Archipelago. All the data show that the hawksbill females have important connectivity between these areas. Regarding support for sea turtle camps, we helped five of them along the Mexican Pacific coast with material for daily fieldwork: Isla Ixtapa, Teopa, Majahuas, Jaltemba, and Mayto. Thanks to this, for the nesting season of 2022-2023, 5,538 sea turtle nests (olive ridley, black, and hawksbill turtle) were protected, with the release of 342,549 hatchlings. Also, we identify the San José mangrove in the Gulf of California as a priority feeding site for juvenile hawksbill turtles. For this, we did an expedition in 24 mangrove areas in four states on the Mexican Pacific coast (Sinaloa, Sonora, Baja California, and Baja California Sur). We found 67 hawksbill individuals in the San José mangrove. At the same time, we tagged 19 hawksbill turtles with acoustic transmitters, and there is a record of 10 of them that has area fidelity. For public policy, we updated the official hawksbill conservation action program with the Mexican government and other local partners' support. We organized a participatory process with 60 researchers, government officials, community leaders, and other organizations. Finally, for communication, WWF Mexico developed an environmental education program called "*La Naturaleza En Tu Escuela*". Through it, we have given talks about olive ridley, leatherback, and hawksbill turtles, reaching about 6,000 students and more than 5 million interactions on the web. Also, we generated products such as infographics of the three marine turtles mencioned before and one of all Mexican marine turtles. In 2021, we presented a documentary available on a streaming platform (Claro video), and we have at least two short videos of our projects.

PROGRAMA TATÔ: COMMUNITY BASED SEA TURTLE CONSERVATION IN SÃO TOMÉ ISLAND, WEST AFRICA

Betania Ferreira-Airaud, Frederic Airaud, Maria Branco, and Sara Alexandra Vieira

Associação Programa Tatô, Avenida Marginal 12 de Julho, Cidade de São Tomé, Ilha de São Tomé, República Democrática de São Tomé e Príncipe

São Tomé and Príncipe unique islands harbors five of the seven sea turtle species that exist in the world and offers optimal conditions for these endangered species both on the beaches and foraging sites at sea. Sea turtles might have been exploited since the 16th century in São Tomé and Príncipe until nowadays, but conservation and research initiatives in the past decade have improved our knowledge of these species, highlighted their importance regionally and globally and prioritized their protection. Programa Tatô has been the key driver of turtle research and conservation in São Tomé Island since 1998. This organization, initially focused on monitoring nesting activity, has progressively engaged a wide range of stakeholders to tackle the complex socio-economic challenges and the threats still persisting in the country. Programa Tatô has been able to demonstrate in recent years the importance of working with an integrative approach on a wide range of fields such as research, monitoring and protection of critical nesting and foraging grounds; advocacy and law enforcement; capacity building; education, communication and public outreach involving all the different sectors of the society; and the development of alternative livelihoods such as ecotourism and the socioeconomic reconversion of former poachers and sea turtle traders. Thus, the success of conservation efforts strongly depends on the commitment and direct integration of local communities into sea turtle protection and conservation actions. One of the greatest achievements of Programa Tatô has been the commitment of local communities, biologists and national technicians in the conservation of sea turtles. Law enforcement is also becoming increasingly efficient in the country thanks to the increasing involvement of national authorities. Through the adoption of a community-based conservation strategy we have been able to witness a drastic decrease of sea turtle mortality and a gentle and progressive recovery of the sea turtle populations of São Tomé and Príncipe. Here, we present the main actions developed and results achieved on the last years by Programa Tatô and a comprehensive framework for implementing a holistic and integrated sea turtle conservation project to improve the protection and sustainable management of sea turtles and their main habitats in São Tomé and Príncipe.

*STRANDING PATTERNS OF *CARETTA CARETTA* IN SOUTHEASTERN AND SOUTHERN BRAZIL: HIGH (AND INCREASING) MORTALITY RATES

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This study evaluated *Caretta caretta* stranding data obtained by the Santos Basin Beach Monitoring Project (PMP-BS), an IBAMA constraint related to oil and natural gas exploration on the Santos Basin by PETROBRAS, to contribute in elucidating knowledge gaps and improving impact mitigation actions for the species conservation. The strandings were obtained by PMP-BS from 2015 to 2020, between Rio de Janeiro and Santa Catarina Brazilian states. The total of 2795 stranded individuals revealed high *C. caretta* mortality rates for the region, composed mainly by late juveniles and adults, with a mean curved carapace length of 77.75 cm (± SD 10.82). We also identified a sexual proportion of 2 females to one male and a mean age of 15.3 years (± SD 3.95). Anthropogenic interactions related to bycatch and plastic ingestion directly affected 266 and 116 loggerheads. We detected stranding hotspots from the south coast of São Paulo to the north coast of Santa Catarina, with seasonal incidence increasing from winter to spring and decreasing from spring to fall (overlapping the shrimp trawling suspension period – from October to May). Overall, our results suggest high levels of mortality rates for juvenile loggerheads and indicate the urgency of strengthening conservation efforts to reduce impacts in the SWA-RMU.

*AN ETHICAL TOOL FOR THE LIFE ASSESSMENT OF LONG-TERM MARINE TURTLES IN RESCUE CENTERS

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The decision regarding the release or the end-of-life of sea turtles housed in rescue centers involves choices that derive from the evaluation of multiple factors. Unfortunately, in the scientific literature there is a lack of attention to this topic and there are no ethical assessment tools in the context of the conservation of marine turtles. It is never easy to assess the real state of a sea turtle in relation to release, especially in specimens with amputated limbs or congenital diseases, which may show different attitudes and adaptations to the handicap, also based on the stall period and the capacity of the tanks where they are hospitalized. It should also take into account the documents of turtles released after many years of stay in the structure and turtles that already had disabilities for a certain period before being recovered. The tool was tested and perfected using four long-standing sea turtles (two with lack of both front fins, one with lack of one of the front flippers and one with deformation of the carapace and problems with the rear fins) subjected to periods of environmental enrichment. The tool that we propose for an ethical assessment takes its starting from an ethical matrix. Stakeholder interests and potential conflicts of values are analyzed. A correct evaluation of the may facilitate a weighted decision based on the diversity of cases. The constitution of a coherent decision-making flowchart helps managers of rescue centers to face a weighted ethical decision, not only on the basis of ethological and medical data and observations, but also considering the dignity of life that turtles may have in the artificial environments or in the open sea.

INTERNATIONAL POLICY ACTION TO ADDRESS UNSUSTAINABLE TAKE, USE AND TRADE OF HAWKSBILL TURTLES IN SOUTH-EAST ASIA AND THE WESTERN PACIFIC OCEAN

Heidrun Frisch-Nwakanma[1] and Christine Madden Hof[2]

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[2]*WWF*

In June 2022, Range States agreed on a new international *Single Species Action Plan (SSAP) for the Hawksbill Turtle in South-East Asia and the Western Pacific Ocean Region*. Adopted already by four countries, Cambodia, Myanmar, Philippines and Viet Nam, several others indicated their readiness to do so soon, and outreach to all Range States is ongoing. The Critically Endangered hawksbill turtle is listed on Appendix I of the Convention on the Conservation of Migratory Species of Wild Animals (CMS). They are also protected in the framework of the Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA Marine Turtle MOU). Both intergovernmental instruments are set up to facilitate cooperation between States and non-governmental actors across the ranges of species which cross international borders. Growing concern about the impact of take, use and trade and the need to address these threats for hawksbill turtle populations in the South-East Asia and Western Pacific Ocean region led to a request by Parties to CMS and Signatory States of the IOSEA Marine Turtle MOU to develop an action plan. This mandate was implemented in collaboration with CMS partner organization WWF, and with extensive consultation of Range States in 2022. The resulting new SSAP seeks to integrate the actions necessary to address take, use and trade at both the domestic and the international level, with the goal "*To address unsustainable use and trade of hawksbill turtles in the South-East Asia and Western Pacific Ocean region and build resilience in the populations"*. The SSAP seeks to achieve three key objectives with 23 associated actions, taking into account the complex linkages between community and commercial use, to: 1. Review and where necessary improve legislation, policy, compliance and enforcement of hawksbill turtle take, use and trade in at least half of SSAP countries in South-East Asia and the Adjacent Western Pacific by 2025. 2. Increase action and improve accountability to further monitor and report on hawksbill take, use and trade nationally and cooperate regionally to exchange data, share intelligence and strengthen collaborations. 3. Further research and evaluate the level of impact trade and fishery activity have on hawksbill populations and deliver on-ground implementation projects by 2027. Here we present an overview of this new SSAP which provides a prioritized framework designed to assist governments in implementing their already agreed commitments from many policy fora, including CMS, the IOSEA Marine Turtle MOU, CITES, regional initiatives and fisheries bodies, in a consolidated and cohesive way to ensure effective conservation of hawksbill turtles.

*SEA TURTLE CONSERVATION AT THE PANAMENIAN CARIBE; WHAT ELSE CAN WE DO?

Raúl García and Roldan Valverde

Sea Turtle Conservancy, Panamá

Since 2003, the Sea Turtle Conservancy (STC) has been working on the Panamanian Caribbean coast, focusing conservation efforts on the most important nesting beaches while working with members of the indigenous and local communities. The STC works on nine different beaches on the Panamanian Caribbean and approximately a total of 50 local workers are hired from families with limited resources in the areas near the nesting beaches each year. The goal is to provide those families with a viable economic alternative so that they do not have to kill them for subsistence. Over the years, a decrease in turtle hunting and egg poaching has been observed in the communities in which the STC works, causing the numbers of Hawksbill (*Eretmochelys imbricata*) and Leatherback (*Dermochelys coriacea*) nests to increase every season, indicating that our conservation efforts are effective. However, due to the COVID-19 pandemic, the confusing national legislation regarding the conservation of sea turtles, and the lack of income during 2020, the families near these nesting beaches resumed their illegal practices, resulting in the take of nesting females and eggs. Unfortunately, the data collected on the beaches show that these practices have not yet returned to pre-pandemic levels. In fact, it seems that the opposite is happening, i.e. more and more turtles are being killed and more clutches poached, although we know that these families no longer require sea turtles for their subsistence. The increase in these illegal activities on nesting beaches during 2020 was understandable. However, after observing these numbers continued increase during 2021 and 2022, the STC decided to implement new conservation strategies. Such strategies include the conduction of as many night patrols as possible, building a house at the monitored beaches to host police and park rangers for extended periods, relocating turtle clutches to different beach areas with less risk to be poached, and building a hatchery on one of the beaches where the poaching pressure is greatest. Unfortunately, poachers also changed their techniques and continue to carry out their illegal practices. It is clear that even with all the efforts by the STC in the area, something important is missing. In 2023, the STC's goal is to reduce these illegal activities to a minimum. To do this, the STC will maximize night patrols, create a larger and safer hatchery, team up with local authorities in patrols whenever possible, provide them with transportation, lodging, and food so that they can patrol the nesting beaches and mating areas, where most hunting is done. Additionally, the STC together with other Panamanian associations and the country's authorities, are developing a new specific law for the conservation of sea turtles in Panama. We think that the long-term objective would be to make people aware of the threats to the local sea turtle populations. In particular, it is essential to make the pertinent authorities understand the importance of sea turtles in ecosystems so that they take the necessary measures to stop illegal practices.

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*NASTNet, A NEW INITIATIVE TO BOOST SEA TURTLE CONSERVATION ACROSS NORTH AFRICA

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The north African beaches and coastal waters host an important proportion of nesting, feeding and overwintering sea turtles in the Mediterranean. This subregion also is also an important fishing, tourism and development area, and is most vulnerable to climate change and economic problems. A group of experts from the five north African countries (Libya, Tunisia, Egypt, Algeria and Morocco), with the support of WWF north Africa have formed a new network composed of both experts and NGOs to boost the conservation work for sea turtles. The network was declared in July 2019 in Tunis, and just successfully achieved its first project with a grant from CEPF to set up its governance structure and establish a five-year strategic plan, in addition, to supporting local organizations to standardize monitoring protocols, exchange experience on conservation action and communication, advise on practical activities, and advocate for improved national and regional regulations and actions for the protection of sea turtles. The network is also assisted by an advisory committee from SPA/RAC, WWF NA, MEDPAN and RASTOMA. In this presentation we will show how NASTNet can help to integrate with existing mechanisms of sea turtle conservation in the subregion and the Mediterranean basin in general, to achieve good environmental status for turtles, with a wide participation of stakeholders from the north African region.

*INTRODUCTION AND IMPACT OF TURTLE FRIENDLY LIGHTING TO CRITICAL SEA TURTLE NESTING HABITAT IN THE CAYMAN ISLANDS

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Green (*Chelonia mydas*) and loggerhead *(Caretta caretta*) sea turtle nesting populations in the Cayman Islands were almost extirpated by the 1800s after hundreds of years of commercial turtle fishing. Today, after 25+ years of conservation and monitoring, nest numbers for both species are increasing and populations are starting to show signs of recovery. However, one of the greatest threats recognised in recent years is loss of sea turtle hatchlings due to artificial lighting from the rapid beach side development in Grand Cayman. Sea turtle hatchlings find their way to the sea from the nest using various cues, including moving away from dark silhouettes and towards reflected light from the moon and stars on the ocean; it is well documented that their orientation is easily disrupted by artificial lighting. This study assesses hatchling misorientations in Grand Cayman over a five-year period (2018-2022) during which turtle friendly lighting (TFL) is introduced to two high-density nesting beaches (Seven Mile Beach and Spotts Beach, which together account for 54% of nesting island-wide). Prior to any TFL being installed in 2018, 70% of nests (n = 131) were laid in locations where artificial lighting would pose a threat to the survival of hatchlings. Nest misorientation rate was 16%, despite 'last resort' interventions (including blocking light sources with large tarps, inducing/monitoring the emergence, or removing hatchlings early for release elsewhere) to 19% of nests in cases where properties refused turn lights out. In 2019, all property owners living on high density nesting beaches (defined as critical nesting habitat), were offered funding assistance from the Cayman Islands Government to change their lights to TFL alternatives. As this was not a legal requirement for existing properties, the uptake was slow, but by 2022, fourteen properties (12 of which were large condominium complexes) had installed TFL on the beaches used in this study. As properties changed their lights, a decrease in overall misorientation rates each year was recorded. In the 2022 nesting season, the proportion of nests laid in TFL locations was 41% and 17% of nests were in undeveloped lots (n = 294). Though the remaining 42% of nests were still laid in high-risk locations, the misorientation rate and intervention rates were the lowest recorded (7% and 15%, respectively). Furthermore, we present evidence for increased nesting at properties with TFL installed, in comparison to those without. Lighting is a major anthropogenic threat to sea turtle hatchling survival and can be easily managed with TFL. TFL reduces the need for interventions to nests, which have unknown, but likely negative impacts on the important final stages of hatchling development. Our study demonstrates the need to introduce legislation for TFL on sea turtle nesting beaches to enhance the protection of endangered sea turtles.

*FIFTEEN YEARS OF HAWKSBILL (*ERETMOCHELYS IMBRICATA*) CONSERVATION IN EL SALVADOR: A HISTORY OVERVIEW AND LESSONS LEARNED

Ana Vilma Henriquez Pocasangre, Sofía Beatriz Chavarría Pérez, Melissa Ivette Valle Linares, Ramón Neftaly Sánchez Romero, Carlos Mario Pacheco Turcios, and Marvin Ernesto Pineda Menjívar

Asociación ProCosta, El Salvador

The hawksbill turtle is globally considered critically endangered by the IUCN (International Union for Conservation of Nature). This species' populations have declined due to various anthropogenic stressors, including the hunting for its shell and over-extraction of eggs for consumption. The environmental conditions are closely interconnected to the quality of life of the communities living near natural resources,

and in many cases, community-based conservation is considered part of the development process of these community. By the early 2000s, in El Salvador, the hawksbill turtle (*Eretmocheys imbricata*) was believed to be extinct by scientists and practitioners. It was not until the mid-2000's that a group of scientists, in collaboration with local communities, identified in Jiquilisco Bay one of the largest rookeries and habitats for this species in the eastern Pacific region. The follow-up research allowed us to gather valuable information about the ecology of this population, for example, the very peculiar relationship with the mangroves and its short-range life cycle. In 2008, the conservation interest focused on Los Cóbanos based on information from fishermen who identified a sizable aggregation of hawksbill turtles. Likewise, another small population of hawksbills was found in Punta Amapala. When the conservation program was established in these three sites, meetings with the local communities were facilitated, which at the beginning were reluctant to be able to engage in the conservation program. Little by little, the trust with local communities was build and strengthen. One factor that enabled this process was implementing a performance payment for conservation which provided an alternative source of income to egg collectors and allowed the growth, access and engagement with local egg collectors and their families. In 2008, nearly ten collaborators engaged in the program, in 2021, the number of collaborators had increased to nearly 166 people, including fishermen, "careyeros" (egg collectors), lobstermen, community leaders, farmers, and local community guides. Many of them volunteer in some activities or collaborate with information. The impact of ProCosta Association on local coastal communities and the conservation of hawksbill is becoming more notable each year in El Salvador, since the population of this species is increasing, the belief that it was extinct is obsolete nowadays we currently have a record of close to 550 nesting females.

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*OVER 20 YEARS OF THE PROCTMM STRENGTHENING THE CONSERVATION OF SEA TURTLES IN THE COLOMBIAN CARIBBEAN

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The diversity of natural and anthropic aspects has led to cataloging all species of sea turtles under different levels of threat within the IUCN red list. To help to decrease the population detriment and to improve the densities of these reptiles in the Colombian Caribbean in the medium-long term, in 1999, the Sea Turtles and Marine Mammals Conservation Program of the Jorge Tadeo Lozano University-Aquarium Marine World was born (ProCTMM). After 23 years of application of *in situ* and *ex situ* conservation strategies, and thanks to the participation and constant support of various stakeholders (11 private companies, 2 CARs, 2 Associations, one committee, 2 NGOs), the Program has managed to expand its actions permanently in Magdalena and La Guajira and participate on projects in 4 Departments among both coasts of the country. As a result, there has been continuous monitoring for 14 years in nesting beaches in the Mendihuaca-Don Diego Sector in Magdalena (21.4 km), extending to the south of La Guajira Department in 2012 (18.74 km). The season is covered by trained community members, linking to a Committee, two Artisanal Fishermen Associations, and a Departmental Educational Institution. On the other hand, 4,525 hatchlings have been head-started in closed systems with their subsequent introduction to the natural environment in 33 Events and the awareness of at least 100,000 visitors a year in the Mundo Marino Aquarium. Additionally, during the head-started processes, ethological catalogs of 2 species (*Caretta caretta* and *Eretmochelys imbricata*) were developed. Also, eight specimens of two species had been tracked with satellite telemetry in the Caribbean basin, and seven international and three national reports were recorded through plastic marks. Meanwhile, thanks to molecular biology studies, we found four haplotypes of *Caretta caretta* shared with populations from the United States, Colombia-Mexico, Brazil, the Mediterranean Sea, Cape Verde, and Cuba. All these actions have been possible thanks to the participation of 253 volunteers between nationals and internationals. As well as students, generating 28 undergraduate projects, 2 MSc degrees, and 35 internships. In conclusion, the continuous actions of the ProCTMM in the region have caused the articulation of the stakeholders, enhancing the union of forces and installed capacities. This allows visualizing the applied conservation actions, beginning to perceive a more encouraging panorama for these sea turtles due to the appropriation and identification of the community with the resource, evidenced in an increase of sightings reports of juveniles and adults and individuals that have been handed for rehabilitation processes.

MANAGE, SECURE AND COLLABORATE: TORSOOI DATABASE NEW VERSION

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The key to the conservation of threatened species such as sea turtles is the collection and analysis of data over long periods of time and through consistent scientific protocols. The main challenge facing scientists working on population monitoring and managers working on their conservation today is to secure, preserve, and allow sustainable access to these valuable long data sets. To date, several databases have been developed for this purpose, but they are mainly dedicated to a specific territory or organization. Sea turtles, as migratory species, know no borders and can share several countries and meet many scientists and organizations during their lifetime. Therefore, data collection protocols and databases should be standardized and applied to all habitats used by sea turtles throughout their life cycle and shared between countries and organizations to facilitate their monitoring and improve their conservation status. TORSOOI database has been developed to address these issues. Its main objective is to promote the harmonization and standardization of data collection and recording, and to facilitate data exchange between organizations and researchers. It is designed for data collected on sea turtle populations or long-term monitoring programs of individuals, as well as threats. It records data on individual surveys (tag recapture, photo identification, and biometrics), reproduction (crawls, nests, hatchling), and distress and mortality (including bycatch). Specific software has been implemented to manage photo identification data and allow rapid recognition of individuals. Among several data search tools, TORSOOI can organize, synthesize and produce preliminary reports of particular interest to managers and stakeholders. After nearly 10 years of development, several improvements have been made to better meet the needs of scientists and the specificities of the territories. More recently, a strong involvement has been established in data management and sharing through collaborations. TORSOOI V2.1 now offers a combination of features that allow both data recording and security according to international recommendations for minimum standards and format, and multiple levels of data access with shared ownerships through collaborative programs. The database is accessible worldwide via an Internet connection and free of charge after creating a personal account. Other levels of access may be granted to managers, such as MPA managers. In this case, formatted reports (.PDF) can be downloaded in a few minutes. Although TORSOOI was first created for data management in the southwest Indian Ocean, it is now more suitable to a wider range of regions and territories. Not only for the photo identification software, for which TORSOOI is best known, but also for other standard monitoring on sea turtles. To date, 11 countries, representing 73 sites and 143 users are referenced in the system. A total of 203,557 data are registered. TORSOOI V.2.1 offers very relevant functionalities for scientific research and can easily feed into monitored indicators of managers. Further improvements are planned for the future, mainly focussed on statistical analysis.

OUR ARMADILLO PROBLEM: 2018 - A TURNING POINT

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Coastal Wildlife Club (CWC) volunteers monitor sea turtle nesting activity on Manasota Key, a 14-mile-long (22.5 km) barrier island in southwest Florida. Nesting density here is the highest on Florida's gulf coast. In 2022, we documented just over 5500 nests, loggerhead (Cc) and green (Cm) combined. We walk daily during the May through October turtle season. For patrol purposes, the key is divided into 19 zones. Northernmost is Zone 1, undeveloped, about **.**75 miles long (about 1**.**2 km) and part of a public Sarasota County beach park. Here as elsewhere on this key, over the years, predation occurred but sporadically and varying year to year in severity and in predator species. Predator management was not a priority until 2010, when predation on Zone 1 was documented at 43% (46 of 107 nests), mostly by raccoons (*Procyon lotor*). By 2017, predation on Zone 1 reached 57% (211 of 367 nests), mostly by armadillos (*Dasypus novemcinctus*). Predators also included coyotes, raccoons, a combination of these, and unknown, but armadillos were the most frequently identified predator in 2017 and in the previous three years. And though tracks sometimes indicated the presence of more than one predator species, in most instances, (70% in 2017), the destruction was by a single species: armadillos. Attempts to manage predation had included professional trapping by USDA (US Department of Agriculture) Wildlife Services and by private contractors, but in targeting armadillos, the results had been disappointing. Screening nests can be effective, but because screens are hazardous and polluting, we prefer removal and euthanasia especially for non-native predators. By September of 2018, because of a severe and prolonged red tide that year, patrollers on Zone 1 had been walking for months in near isolation, disheartened by a beach littered with dead fish and other marine life, and, as usual, encountering multiple predator-destroyed turtle nests daily. In desperation, we decided to try trapping *ourselves*. We continued the following year. In 2019, nest density on Zone 1 was the highest on Manasota Key, though fewer than 20% of the 451 nests documented were predated by armadillos or other predators. In 2020, 2021, and 2022, patrollers on Zone 1 noted occasional armadillo tracks on the beach but no armadillo predation and minimal destruction by other predators. We will discuss our trapping efforts, what took us so long to trap, and lessons learned that might benefit other projects.

*SOCIALISATION AND CHALLENGES IN THE IMPLEMENTATION OF TURTLE EXCLUDER DEVICE (TEDS) IN MALAYSIA

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Bycatch poses the single greatest fisheries threat not only to juvenile and trash fish but also to many charismatic large marine megafauna, including sea turtles. In Malaysia, the fishing industry is dominated by trawl fisheries, contributing almost 50% of overall fish landings, and leads to a high mortality of sea turtles accidentally caught in these fishing nets, especially by bottom shrimp trawlers. Every year, thousands of sea turtles are lost to bycatch. The Marine Research Foundation (MRF) started introducing Turtle Excluder Devices (TEDs) in Malaysia in 2007. After a decade of hard work and commitment, TEDs became a legal requirement in four States in Peninsular Malaysia in 2017. In Malaysia, the TED adoption story is an interesting but challenging one, as it entwines government policy, politics, international diplomacy and of course fishers and turtles. There have been multiple challenges in getting TEDs to be implemented in the State of Sabah, contrary to the rest of the States in Malaysia. Fisheries management and conservation across Malaysia are generally governed by the Fisheries Act 1985 (revised 1993) with provisions detailing the conservation, management and development of fisheries, which also covers Sabah.

Pursuant to the formation of Malaysia in 1963 and the constitution of Malaysia, the management and development of fisheries in Sabah is viewed strictly as a state matter. Even though the Federal Government have decided to implement TEDs in several States across Peninsular Malaysia, Sabah has the rights to decide whether to implement TEDs in the State. Due to the endless political crisis in the country, Malaysia has seen too many changes in the Government structure too many times, including Sabah. It has been a challenge for us to continue to get continuous buy-in from the Sabah Government especially from the Department of Fisheries Sabah (DOFS), as we have seen several changes in the organisation structure that hinders us from getting the full commitment from DOFS. Even if we have trained many DOFS officers over the years since we started the programme, soon enough, the changes of teams internally would mean we would be meeting a new team of officers as quickly as the year after. The crucial part of this implementation process is the continued commitment and engagement of the Government. We know that voluntary adoption is ineffective, so legal requirements for TEDs and buy-in from fisher communities will be the only way this will work. The Government has shown an on-and-off commitment to the process so far, and we feel that provided MRF continues to play the catalyst role, the TEDs programme will succeed. MRF has built a strong working relationship with the Department of Fisheries Sabah, and we will continue to work towards eventual legal requirements. We are confident we can continue to positively influence this process until Sabah becomes a TED-compliant State.

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*MITIGATING SEA TURTLES BYCATCH ON THE PERUVIAN MAHI MAHI LONGLINE FISHERY: A SUCCESS STORY AFTER 18 YEARS OF WORK

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Bycatch is the most important threat to sea turtles worldwide and in Peru interactions with mahi mahi *Coryphaena hippurus* longline fisheries are highly frequent and involve all 5 sea turtles species occurring in this country. Instant mortality is usually very low but assessments on the types of interactions and common handling techniques used by fishers, post-release mortality could be assumed to be significant. The mahi mahi longline fishery has grown since the 90s to now being the second most important artisanal fishery in the country (more than 2500 fishing vessels) with most of its production being commercially exported (13.3 thousand tons exported in 2021) and almost 80% going towards the US market. Since 2004, WWF Peru has worked trying to reduce the threat from this fishery on sea turtles and since 2012 has been promoting a FIP to obtain the MSC certification with sea turtle bycatch as one of the core issues to address. Efforts have been conducted in many different fronts including testing circle hooks (844 fishing sets and 210 364 hooks observed), researching sea turtles' injuries from longline fishing gear, developing handling and release guidelines, training trainers and fishers, supporting the development of a National Conservation Plan, and working strongly with the fisheries sector including fishers, processing and exporting industry and managers. We even helped create the Peru Mahi Alliance which is formed by 14 mahi mahi industry members (80% of the market volume) committed to achieving the sustainability of the fishery and obtaining the MSC certification. All this work contributed to the enactment, in 2021, of the Mahi mahi Fishery Management Regulation which included provisions for the conservation of sea turtles making it mandatory for each fishing vessel to carry tools, having one certified crew member on best sea turtle handling and release practices, implementing a logbook to detail any by catch interactions, and allows further regulation on hooks to reduce bycatch (size, type and number of hooks). Currently we are supporting the process of developing a training and certification program for fishers by the national agency FONDEPES and the publication of the official guidelines by the Ministry of Production in coordination with IMARPE and SERFOR. This presentation will show a conservation and management success story which is only being possible thanks to the perseverance of the people involved, the science-based actions and the construction of trust and collaboration with key role players in the management of this fishery.

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*SHELLBANK: A TRANSNATIONAL MARINE TURTLE DNA TRACEABILITY TOOL

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It is estimated that nearly 9 million hawksbill turtles (*Eretmochelys imbricata*) have been harvested for the tortoiseshell trade over the past 150 years. Despite hawksbills and other marine turtle species being listed on CITES Appendix I, the unsustainable use and trade continues to threaten some species survival. Established in 2018 by World Wide Fund for Nature, ShellBank is a transnational marine turtle DNA traceability tool that aims to enable scientists, conservationists and policy makers to track the illegal trade of marine turtles (“sale to source”) and to identify populations most at risk, along with improving research and conservation knowledge. One of the key components is the development of biological reference material and DNA data for the use in research and conservation management programs to identify and track a turtle’s population origin and its geographic (transmigratory) boundary, as well as law enforcement intelligence collection and/or forensic investigation of the illegal trade. Of which, both are mandated by CITES Parties to action. ShellBank works by comparing genetic signatures found in its three databases, a Rookery Baseline Database (nesting animals), an In-Water Database (foraging, stranded, by-catch animals) and a Confiscation Database (poached, traded turtles and manfucatured items). Here we present an update on ShellBank which is now ready to be taken from pilot into practice. ShellBank first showcased DNA shell extraction in 2019 (LaCasella et al., 2021) and piloted a project of how ShellBank can work in practice in 2022 (Surrender Your Shell Report, 2022). ShellBank’s toolkit consists of DNA reference and confiscation databases, capacity building and training workshops, and other resources such as standard operating protocols. It is only possible as a result of many international partnerships. The turtle conservation community has tripled the number of sample locations recorded in ShellBank’s Asia-Pacific database during 2018-2022. More than 650 samples from 18 locations have been collected and are in the process or in the queue to be analysed by local research groups across Asia Pacific. Several ShellBank training sessions have been provided to over 65 researchers, and over 60 law enforcement officers across multiple countries. But more work is needed to grow the databases and secure its uptake as a traceability tool. The next phase of ShellBank is to roll out the standardised framework for DNA collection and analysis to law enforcement, forensic laboratories, and conservation researchers across the globe, expanding from hawksbills to include green and leatherback turtles also. This will build a network of countries contributing to the development of ShellBank as a conservation management, wildlife forensic and law enforcement tool.

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*FIND THE TUNISIAN PIECE OF THE CONSERVATION PUZZLE: TunSea AS A PLATFORM TO COLLECT DATA ON MARINE TURTLES IN TUNISIA

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In Tunisia, as in the Mediterranean Sea, three marine turtle species (the loggerhead, the green, and the leatherback) are observed. They and protected by international treaties and national laws. The Mediterranean region has seen a steady rise in interest in marine turtles over the past forty years. The main reason for this rise has been attributed to conservation issues, particularly the need for appropriate knowledge of the dangers they confront and the biological and ecological criteria necessary for their conservation. In order to support conservation efforts, many monitoring and conservation programs were put into place to identify concentration regions, nesting and feeding grounds, and causes of mortality. Recently, Citizen Science initiatives are gaining popularity as a practical method of gathering data and public awareness for environmental conservation. In August 2020, during the COVID epidemic, a new citizen science platform called "TunSea" was launched in Tunisia on Facebook to build a link between all actors engaged in marine conservation in order to share knowledge about marine creatures, observations and reports on specific species and events and raise awareness. More than 39,000 people have joined this platform since it first started. TunSea has become an aid for collaborative marine science in Tunisia. This community has quickly grown in popularity, bringing together decision-makers, scientists, and other interested parties like fishers, aquaculturists, and sea users. Sea turtles were one of the species that attracted more attention in the TunSea group. Numerous sea turtles, dead or alive, accidentally caught in fishing gears, and recordings of fishermen releasing turtles into the sea have been uploaded on the TunSea platform to identify them or gain experts' opinions on their presence in a particular area of the Tunisian coast. The number of sea turtles, their location, and the date of the observations was pulled out from more than 300 photos to have the spatial-temporal distribution and the abundance. Results show that the loggerheads turtle *Caretta caretta* was the most abundant species and new nesting sites have been identified. Moreover, the causes of death, the number and distribution of turtles caught in various fishing gears, and the number of turtles rescued and transported to rescue centers were recorded. These findings help us better understand the biology and ecology of these threatened species. They also encourage us to develop research on other species and adapt the "TunSea" initiative to other fields of study.

EFFICIENCY OF CITIZEN SCIENCE TO IDENTIFY NEW MARINE TURTLE NESTING SITES IN TUNISIA

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The Mediterranean Sea hosts local populations of two species of marine turtles, the loggerhead turtle *Caretta caretta* and the green turtle *Chelonia mydas*, as well as a limited number of leatherback turtle *Dermochelys coriacea* entering from the Atlantic Ocean. The Mediterranean Sea hosts 52 and 13 major nesting sites for loggerhead turtles and green turtles, respectively, but also many minor nesting sites and sporadic ones which continue to appear in relation to the climate change effect. In Tunisia, recent studies have been conducted to identify nesting sites along the coasts. These studies show that the majority of Tunisian beaches are suitable for nesting phenomenon. In order to support conservation efforts, and to identify new nesting sites, many monitoring programs were implemented in most Mediterranean countries. In this context, Citizen Science initiatives are gaining popularity as a practical way to improve data collection, public awareness, and environmental conservation. In August 2020, during the COVID epidemic, a new citizen science program called "TunSea" was launched in Tunisia with the aim of bridging the information gap between the public and the scientific community regarding sea Turtles conservation. TunSea members (39000 people) who have already been made aware of the nesting phenomenon through publications showing good practices when encountering egg-laying turtles have uploaded photos and videos showing female turtles laying eggs, baby turtles returning to the sea, and tracks of females on the beaches to the group since the creation of this platform and during the summer seasons. Since the "TunSea" group was established, more than 300 posts concerning sea turtles were uploaded, of which ten were related to nesting activity. These reports permitted us to locate new nesting sites and provide a springboard for the TunSea group to increase its efforts to gather additional data at other locations. These results aid in our better understanding of the ecology and the expansion of the nesting area at the national and regional levels of these endangered species. Additionally, they exhort us to expand our research into other species and to encourage colleagues to apply the "TunSea" idea to other academic disciplines.

SEA TURTLES CONSERVATION IN PUNTA ILENDE NATURAL RESERVE IN THE CONTINENTAL REGION, EQUATORIAL GUINEA

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The beach immediately north of the Aye River mouth is one of the most important nesting sites in Continental Equatorial Guinea. The nearby village of Aye is composed primarily of fishermen targeting fish and lobster, while sea turtle consumption has been virtually eliminated. TOMAGE (Sea turtles of Equatorial Guinea) has been working for 6 nesting seasons (2012-2018) with local fisherman Benito Masongo, who is fully committed to sea turtle conservation, beach monitoring and transplantation of threatened nests. During the 6 nesting seasons, 60 leatherback nests were recorded, as well as 150 olive ridley nests. Despite Benito's in-situ efforts, many nests were predated by monitor lizards (*Varanus niloticus*) arriving from the nearby forest to patrol the beach at dawn. This weak nesting incidence confirms the downward trend experienced on the mainland nesting beaches in the last 6 years, contrary to the increasing trajectories recorded elsewhere, particularly for olive ridleys. It is evident that the continued exploitation of adults and eggs is heavily impacting the population. Due to beach erosion and predation (also experienced inside last year's hatchery due to ants), Benito focused on transplanting nests to hatchery and Styrofoam boxes, with surprisingly good success. Each nest was identified with date, ID, species and number of eggs, and followed through to hatching and emergence. In 6 years, Benito released 10,000 hatchlings. What was traditionally the highest-density section of the beach, approximately 1 Km north of the Aye river mouth, has become less suitable for nesting due to coastal erosion. Patrols were therefore extended further north and south, to cover approximately 5 Km, apparently more favorable for nesting. However, due to these areas being closer to the more populated villages of Ilende and Sofoge, higher levels of poaching were recorded of both adults and nests. Benito's commitment to the conservation of sea turtles has been a great achievement. His work has helped promote and inspire stronger protection of the Ilende Natural Reserve and coastal biodiversity nationwide; thanks to this example more Equatoguineans have joined in TOMAGE's efforts to protect endangered sea turtles.

NESTING BEACH MONITORING BY RESIDENTS OF THE SEMI-AUTONOMOUS NGÄBE-BUGLÉ INDIGENOUS REGION, ÑÖ KRIBO, PANAMÁ, PROMOTES SEA TURTLE CONSERVATION

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The Bocas del Toro region of Panama encompasses feeding grounds, nesting beaches and migratory corridors for four species of sea turtles: leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*) and loggerhead (*Caretta caretta*) and is one of the most important regions for sea turtles within the Caribbean. There is a long history of exploitation of sea turtles by its culturally diverse population. It is likely that the town of Bocas del Toro originated as a turtle-fishing camp. Sea turtles are part of the regional symbols, featured on the provincial flag and in the provincial anthem. But decline of sea turtles on this coast is well documented. A highly-organized take of hawksbills from regional nesting areas from 1800 to 1990 mainly involved harvesting for the international trade in tortoiseshell. Aerial and ground surveys and interviews in the early 1980s suggested that nesting had declined as much as 98% from the early 1950s. Extensive harpoon and net fisheries targeted green turtles and hawksbills at least until after the turn of the century, and some illegal fishing continues to date. During the 1990s, Ngäbe-Buglé indigenous communities requested from Panamanian federal authorities the division of the provincial territory to create a separate, semi-autonomous Ngäbe-Buglé Comarca. The organization, administration, and operation of the indigenous region are subject to a special regime established in Law # 10 and the constitution of Panama. In 1996, local interest on the part of the indigenous community of Río Cañas to conserve hawksbill turtles that nest on Chiriquí Beach led to the formation of the Association for the Protection of Natural Resources Ngäbe-Buglé. Initial protections were implemented that allowed the capture of turtles only every other year. From 1999–2002, field research provided preliminary indications of the problems faced by nesting turtles and revealed the interest of the communities in conservation. Beginning in 2002, meetings between local organizations (Environmental Ministry and Regional Congress Ñö Kribo of the Ngöbe-Buglé Comarca) and international conservation groups (Sea Turtle Conservancy, US Fish & Wildlife Service, Wildlife Conservation Society) resulted in an agreement with indigenous authorities to carry out biological investigations and recovery of sea turtles. The development of community-based conservation groups and the collection of season-long nesting data by community members supported the designation of two protected areas in the coastal region of Ñö Kribo: the Damani-Guariviara Wetland of International Importance (2004), a RAMSAR site, which consists of 24,089 hectares, including the entire 24-km Chiriquí Beach, and the Protected Landscape Isla Escudo de Veraguas-Degó Island (2009) with marine (41,596 hectares) and terrestrial (533 hectares) components. Beaches within these two protected areas now contribute to the regional recovery of hawksbill populations. In the last 18 years, there has been a reduction in the illegal killing of turtles at most nesting beaches in the area, and a positive nesting trend for leatherbacks and hawksbills. There is no longer any legal take of sea turtles in Panama.

GREEN TURTLE AS FLAG SPECIES FOR A POTENTIAL COASTAL-MARINE PROTECTED AREA IN MALDONADO, URUGUAY

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Playa Verde in the Department of Maldonado (Uruguay) is an area with rocky bottoms, being almost the last place with a high presence of seaweeds towards the inner zone of Río de la Plata estuary (RdlP) and presents a high frequency of occurrence of juvenile green turtles (*Chelonia mydas*). This area also has a high influence of the RdlP estuary, presenting a high variation in temperature and salinity. This site is part of an area that has relevant and priority biodiversity for conservation, where macroalgae, invertebrates, bony and cartilaginous fishes, sea turtles, and marine mammals, among others, are found. In turn, it is an area with a high presence of anthropic activities carried out by local communities, artisanal fishers, and seasonal residents. The main objective of our project is to carry out an exploratory study of Playa Verde to generate information for the creation of a potential coastal marine protected area in the department of Maldonado, Uruguay. To carry out our research project, we will use the green turtle as a flagship species, since this is a priority species for the coastal ecosystem and the area was identified as a feeding area for juveniles of this species in Uruguay. Through activities such as diving and the use of underwater cameras, promoting scientific and recreational diving (tools little exploited in Uruguay). Two types of samplings will be carried out 1) Underwater transects to count the green turtle individuals that use the area and registered other mobile species and 2) Intertidal transect to identify and quantify the presence of seaweeds and benthic invertebrates. The preliminary results include about ten species of benthic invertebrates, which were among the most abundant and diverse groups found, which were observed and processed through sampling carried out in the intertidal zone of Playa Verde. Among the invertebrates present, polychaetes were the largest, followed by amphipods, mussels and anemones. When disseminating the results, environmental education will be used as a tool to promote the importance of conserving these priority species, based on meetings with schools and training centers, with the community, and with local fishers. This project is expected to start a solid database, through the use of research and education tools, to provide

a baseline for a future application of this area as a new coastal-marine protected area to the National System of Protected Areas in Uruguay.

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*HEADSTARTED GREEN TURTLES EXHIBIT INCREASED SURVIVAL TO ADULTHOOD AND THE CAPACITY TO RECOVER WILD, DECLINING POPULATIONS: A CAYMAN ISLANDS CASE STUDY

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The global decline of marine turtles has inspired a variety of conservation actions, including headstarting. This short-term captive rearing before wild release targets the highly vulnerable hatchling life stage and aims to release fitter individuals by maximising early-life growth rates. The impact of headstarting programs has been quantified in freshwater turtles, but not marine turtles due to few long-term, large-scale programs. The Cayman Turtle Centre released over 31,000 juvenile green turtles from 1980-2001, and the wild population simultaneously recovered from extirpation. To attribute any credit for wild population recovery to the captive release of headstarted turtles, a population viability analysis was performed to compare population trajectories with and without captive releases. This study presents the first quantification of marine turtle headstarting impact, by comparing nesting female abundance between simulated scenarios: with and without captive releases. Headstarted releases of Cayman Island green turtles were shown to have a quantifiable and positive impact on survival to recruitment, and with headstarted individuals contributing an additional five nesting females for each 1000 headstarted turtles released. Headstarted releases have extended the predicted population extinction, from 1848 to 2131; indicating that the Cayman Turtle Centre releases have largely contributed to the recovery of the wild population. This work provides the first evidence that headstarted marine turtles can provide a survival advantage that could result in population recovery, and these findings can inform conservation management efforts for other similarly imperiled marine turtle species.

NETWORK FOR THE CONSERVATION OF FRESHWATER TURTLES, TORTOISES AND SEA TURTLES OF COLOMBIA (RedTCM): AN INITIATIVE OF COLLABORATIVE WORK TO PROMOTE THEIR SURVIVAL AND ADVANCE THE STATE OF KNOWLEDGE OF THEM

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In December 2018, during the *2nd Colombian Congress of Herpetology*, a group of 23 academics, researchers, and conservationists interested in contributing to the appreciation and conservation of the turtles present in the national territory formed the Network for the Conservation of Freshwater Turtles, Tortoises and Sea Turtles of Colombia (RedTCM). At present, it is comprised of members from different areas of the country with diverse institutional affiliations (universities, zoological parks, research institutions, and NGOs). Its objective is to support and promote research, dissemination, legislation, and policies that contribute to the conservation of turtle species in the country. During its four years of existence, the RedTCM has focused on three fronts: i) Revision and updating of information, like the *National Programs for the Conservation of Freshwater Turtles, Tortoises and Sea Turtles*, and the state of knowledge on the richness and distribution of species, ii) Instruction and training, by means of workshops and theoretical-practical courses, and iii) Dissemination and divulgation of knowledge by means of specialized symposiums and communication in social media. Some activities worth mentioning are: i) A preliminary evaluation of the advances in fulfilling the *Strategy for the conservation of freshwater turtles, tortoises and sea turtles in Colombia (2015-2020)*; ii) An actualization of the checklist of turtles of Colombia, in which we documented evidence that 33 species and two subspecies occur in the country, of which five are sea turtles and 28 are terrestrial or freshwater turtles. Colombia possesses nine turtle families, 17 genera and is second in South America to Brazil in terms of the number of living species, with over 43% of the species threatened, but that threat levels are not equally distributed by family or region, with similar classifications of national threat levels found in the five South American countries with greatest richness in turtle species, including sea turtles and podocnemidids (except the podocnemidids of Brazil); iii) Support for the development of the *Theoretical-practical course Biology and Conservation of Testudines* conducted in June 2019; iv) Participation in developing the models for the Group of Turtles of Colombia in *BioModelos*, organized by the Alexander von Humboldt Biological Resources Research Institute; v) Co-organization of three symposia, the first two during the *5th Colombian Congress of Zoology* (Bogota, 2018), one on sea turtles and the other on tortoises and freshwater turtles, and in 2022, the *1st Integrated Symposiumon the Study and Conservation of Freshwater Turtles, Tortoises and Sea Turtles of Colombia*, offered during the *3rd Colombian Congress of Herpetology*. The advances that this organization has achieved shows the efficiency of collaborative and integrated work to carry out and lead projects that contribute to the knowledge of the Testudines. At the same time, the RedTCM confronts important challenges to its survival and consolidation, that means not just affiliating of new dedicated and enthusiastic members, but also attaining an organizational structure that facilitates and promotes the development of innovative projects that contribute to the survival of sea turtles, tortoises, and freshwater turtles of Colombia.

EUROWA NETWORK: PREPARING TO BETTER RESPOND IN CASE OF OILED SEA TURTLE INCIDENTS IN EUROPE AND THE MEDITERRANEAN BASIN

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The EUROWA (European Oiled Wildlife Assistance) network aims to strengthen Europe's capability to deal with wildlife pollution emergencies via holistic/integrated pollution management, mutual assistance between coastal countries and the availability of a European network of internationally qualified EUROWA experts. EUROWA can be activated via the EU Civil Protection Mechanism and officially mobilized by any EU member state in case of an emergency situation. The network has a pool of qualified experts to be sent in such a situation. EUROWA has also developed a training portfolio at different levels (basic, advanced, specialist, manager, etc.), with all training courses and manuals based on best practices and standards. This cooperation provides a work force of trained and aligned responders who can mobilize internationally for an emergency and work alongside local responders educated to the same standards. So far EUROWA activities have been mostly focused on oiled birds. In 2022, however, two sea turtle responder manuals (Basic and Advanced level) and a training package for oiled sea turtle response were developed, mainly aimed at the Mediterranean basin (European and non—European) and specific areas of Atlantic Europe where sea turtles are more common (such as Canary Islands and Azores). The manuals accompany the training package, with Basic and Advanced training courses, which in turn, and depending on the attendees' previous experience with sea turtles, result in Basic, Advanced or Specialist qualifications. These qualifications refer to nesting beaches, as well as to rescue centers. Once the manuals were produced and reviewed by several experts, a training event/workshop was organized in Greece, gathering sea turtle experts from the Mediterranean basin with different backgrounds (sea turtle population study, nesting beaches, work in rescue centers, university teachers, etc.). The main aim was to share the materials produced and present the training courses in order to gather feedback from experts from different countries and expertise. The training event included theory lectures, practical work (washing an "oiled" sea turtle) and tabletop exercises (organizing a response after an oil spill at a specific point and time of year in the Mediterranean Sea; organizing an already existing rescue center to admit an extra 100 oiled sea turtles over one week). Next steps of this project are to officialize the training and extend it to the rest of Europe and the Mediterranean, and further afield, and to exchange experiences with groups from other parts of the world also working on oiled sea turtles, such as the US or Mexico. It is also planned to begin incorporating organizations with expertise on sea turtle response into the EUROWA network membership, to grow the pool of trained responders who are able to assist in the event of an oil spill where sea turtles are affected in Europe.

MARINE TURTLE REGIONAL MANAGEMENT UNITS 2.0: UPDATED FRAMEWORK FOR CONSERVATION AND RESEARCH OF WIDE-RANGING MEGAFAUNA SPECIES USING PARTICIPATORY GIS

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Delineating population boundaries of marine turtles that encompass varied and overlapping geographies across life stages can be a significant challenge for developing coherent conservation strategies. The varied geographic distribution of species range across marine areas overlaps with multiple threats and environmental conditions complicating evaluation of relative impacts and potential conservation priorities. To address these challenges for marine turtles, spatially explicit 'regional management units' (RMUs) were developed in 2010 for all species, globally. RMUs provide a globally consistent framework that organizes conspecific assemblages into units of assessment and conservation above the level of nesting rookeries, but below the level of species, within regional entities that likely share demographic trajectories because they face similar threats and environmental conditions. From their initial conception, RMUs were intended to be improved by new information about marine turtle distributions, life history, habitat use patterns, and population structure. In this poster, we describe the process used to update the RMUs framework by incorporating new information published since 2009 as well as inputs from global experts using participatory GIS techniques. Using the combination of a literature review and participatory GIS the updated RMU framework reflects significant expansion of marine turtle biogeography research and knowledge, and provides improved clarity about the RMU concept and its potential applications. This poster research presents a total of 48 RMUs of six sea turtle species as well as lessons learned from the participatory GIS process in making these techniques applicable to a wider audience through the ArcGIS Online platform. The updated RMU products and supporting files have been made open access for research and conservation initiatives around the world.

*FIVE YEARS OF PROTECTING SEA TURTLES WITH DOGS AND DRONES ON BOA VISTA, CAPE VERDE: A REVIEW

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One of the world's largest and most important nesting populations of the loggerhead sea turtle (*Caretta caretta*) is threatened by a number of man-made factors, most notably the formerly unrestrained hunting of nesting females for meat. Conventional beach patrols, mainly carried out by the local nature agency and several NGOs on allocated stretches of beach, have already led to a significant decrease in the number of turtles killed. Intensive accompanying programs in development cooperation, environmental education, public relations, and advocacy are designed to ensure the sustainability of the direct protection efforts. However, financial incentives from meat trading, with meat now sold as an expensive delicacy, and

inadequate protection in some areas, led to the recorded killing of almost 5 % of the nesting females still in 2017. To further reduce poaching, a project to develop and implement alternative protection methods was launched on Boa Vista in 2018. Working closely with the local nature agency and the police, Fundação Tartaruga and Turtle Foundation are providing extensive expert, financial, personnel, logistical, and technical support to help the authorities enforce the law against sea turtle poaching. The project involves the use of conservation dogs and advanced night vision technology (drones and binoculars with thermal imaging) and their professional application within coordinated operational concepts and strategies. The aim is both to deter and, if this has not helped, to prosecute poaching offenders. Initially, the dog unit and the drone unit were established and trained in parallel. The dog unit was trained to detect turtle meat at transshipment points (e.g., airports, fishing ports) and checkpoints, as well as to search for poaching suspects after detected acts (man-trailing). The drone became operational in August 2018, using a quadcopter drone equipped with a thermal night vision camera. Surveillance operations were conducted daily on randomly selected beaches with a high risk of poaching, often accompanied by police officers. In the first year of the project, the recorded turtle mortality rate fell by almost 90%, from 4.5% to 0.5%. The rate has continued to decrease and was 0.3% in the 2022 nesting season. Further, three poachers were arrested by the police as a result of the Dog and Drone Team's activity. A number of factors may have contributed to the significant reduction in poaching in recent years, including increased legal penalties for poaching and the expansion of NGO community programs. However, we have learned from direct sources, such as the testimony of former poachers, that the significantly increased risk of being caught has regularly deterred potential offenders from their intentions. While many of the project's approaches were experimental and new to sea turtle conservation, strategies and operations have improved significantly over the past five years. Good relations and trusting cooperation with the local authorities have been further strengthened, and the team members with different skills welded together to form an experienced and effective anti-sea turtle poaching unit. In this presentation, we summarize and analyze the strategies and results of the project and provide an outlook on future developments.

BIOBANCO DE TORTUGAS MARINAS DE LATINOAMÉRICA (LATIN AMERICAN SEA TURTLE BIOBANK): AN OPPORTUNITY FOR REGIONAL SEA TURTLE CONSERVATION

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The Latin American Sea Turtle Biobank (Biobanco de Tortugas Marinas de Latinoamérica-BTMLA) is a collaborative effort created in 2021 between sea turtle researchers throughout Latin America to combine resources and knowledge to work towards conservation goals of these species in the region. The main aim of the BTMLA is to collect sea turtle samples to provide baseline information in several collaborative projects in Latin America and allows analyzing genetic diversity/structure, blood biochemistry, hematology, environmental pollutants, and stable isotopes composition, among others, for the different populations of sea turtles in wider scale in the region. The BTMLA comprises 18 representatives from six Latin American countries, including Mexico, Guatemala, Costa Rica, Panama, Colombia, and Chile. The participants work in nesting beaches and feeding ground areas. Eleven are working in the Pacific region, and nine in the Atlantic Ocean (eight in the Caribbean region). The participants belong to 18 institutions; nine of them are universities or higher education institutions, eight are NGOs, and one is a government entity. Six of the sea turtles' species in the region are represented in this network, and the majority of the participants work with more than one species. The most commonly studied is *Chelonia mydas* (88.9%), followed by *Eretmochelys imbricata* (83.3%), *Lepidochelys olivacea* (61.1%), *Dermochelys coriacea* (50.0%), *Caretta caretta* (27.8%) and *Lepidochelys kempii* (5.6%). The participants run simultaneous projects, and most of them work on nesting sites (n=14) and arribada nesting beaches (n=1) and run projects on foraging habitats (n=10) as well. Some also work on fisheries (n=3) and captivity (n=2) projects. All participants develop projects with adult turtles (100%), including females (88.9%) and males (55.6%). However, they also work with juveniles (66.7%). Most participants (66.7%) currently manage sea turtle samples to share and collaborate with other researchers, and the remainder (33.3%) will be collecting samples in the short/medium term. To strengthen and amplify this network, a geometric morphometric sea turtle project started in 2022 based on photographs collected at a regional scale. This project aims to examine patterns of body shape variation of hatchlings, juveniles, and adult sea turtles across the Latin American region to respond to ecology and evolutionary questions and inform conservation recommendations. Being a multinational network, the BTMLA presents challenges towards a unified information bank. Logistic aspects at each site and financial limitations are the main aspects affecting the unification of this network. Furthermore, the lack of consistency between environmental laws and research permits throughout Latin American countries is the main reason for the delay of some processes. In a midterm, the BTMLA seeks to create a biobank where samples from all partners would be stored and kept to be used as required by the network members, thus contributing to regional sea turtle conservation.

TOWARDS THE EFFECTIVE MANAGEMENT OF SEA TURTLES: DEVELOPING A TOOLKIT FOR MPA MANAGERS AND POLICY MAKERS

Anna Safryghin

EU Ocean Governance Project

Over the last 200 years, human activities have tipped the scale against the survival of sea turtles. With commercial fishing, coastal development, pollution and climate change, impacting every life stage, sea turtles are among the most conservation-dependent of marine taxa. The development and implementation of good management plans for the conservation of these species should be an urgent priority. Marine protected areas (MPAs) have been essential in conserving and managing sea turtle populations. However, conservation efforts, management actions and their evaluations are still frequently hindered by a lack of accurate information on both sea turtle biology and ecology and the human social and economic dynamics that influence our ability to effect change in the status of sea turtle populations. To tackle these threats, fill knowledge gaps and empower practitioners, managers, and policy makers to effectively conserve sea turtles, the Marine Mammal Twinning, as part of the EU-funded Ocean Governance project, plans to adapt the successful Marine Mammals Management Toolkit to other mobile species, including sea turtles. The toolkit will aid MPA managers in their efforts to take sea turtles into account in MPA management plans and will comprise of factsheets and a Self-Assessment Tool (SAT). The SAT through a series of graded questions will enable MPA managers to monitor and evaluate the status and effectiveness of the MPA's management plan with respect to mobile species. The toolkit will also be supported by the introduction of a Community of Practice (CoP), a network of MPAs and managers that are working to manage mobile species within MPA frameworks. The CoP will promote knowledge sharing, capacity building, collation of good practices and lessons learnt, and transboundary cooperation, all crucial for the successful conservation of highly mobile species. With proven success of the toolkit in effectively managing marine mammals, the toolkit will equip MPA managers with the resources necessary for effectively evaluating the conservation level of sea turtles within MPA management plans. As with all management and conservation strategies, accurate information is key to guarantee the effectiveness of the toolkit and its successful use. Following the 7th Mediterranean Conference on Marine Turtles, where the objective of including sea turtles within the toolkit was presented to over 100 MPA practitioners and experts working in the Mediterranean basin, our aim now is to translate this cooperation on a global scale. As such, at the 41st International Sea Turtle Symposium we plan to convene experts, decision makers and managers to contribute to establishing a global baseline of knowledge necessary to produce the sea turtle toolkit, aiding in the conservation and recovery of these key species. Echoing the cooperative nature of the toolkit, this occasion will also welcome sea turtle MPA managers into a global network of mobile species MPA practitioners. With more governments committing to the "30x30" Agenda, the danger of "paper" parks is at its highest. Thus, this tool will aid in ensuring that MPAs are equipped, and managers have the capacity, to conserve sea turtles effectively, preserve critical habitats, mitigate threats and protect biodiversity.

SCIENTIFIC RESEARCH AND GOVERNMENT PROCESSES: PARADIGM SHIFTS IN THE CONSERVATION OF SEA TURTLES IN HONDURAS

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Honduras is ranked fifth highest of countries in Central America with continuing high biodiversity, where 56% of national biodiversity is in relation to terrestrial forests. Thus, the greatest efforts toward conservation and management of biodiversity in the country have historically been on terrestrial ecosystems, while marine protected areas (MPAs) have only recently seen efforts toward research and sustainable management. Therefore, the management of MPAs has typically been undertaken based on supposition and intuition, rather than measurable scientific parameters due to the lack of capacity of educational and government institutions to promote scientific research and create parameters that allow adequate and effective management. This is especially true in marine areas where conservation represents a large challenge for resource managers. Being able to carry out scientific research, especially on sea turtles, presents numerous difficulties, beginning with challenging paradigms in order to generate objective data through research studies of sea turtles. Major challenges facing ProTECTOR, Inc. have been social resistance to research and lack of application of knowledge gained. Government personnel who manage natural resources in Honduras tend to formal lack field-based scientific training, resulting in management policies which lack clarity and are left to the speculations of government employees responsible for the oversight of resources. Over the past 16 years, ProTECTOR, Inc. has systematically undertaken conservation research throughout the country, often linking with community groups and providing small-scale training, education outreach, and annual scientific reports of research findings to government agencies and non-governmental organizations (NGOs) responsible for marine conservation management in the country. These efforts have led to hundreds of local community members, NGO personnel, and international visitors receiving environmental education regarding sea turtles in Honduran waters, as well as hundreds of pages of information and publications provided as resources for future marine management planning. By consistent engagement of government agencies, local community members, NGOs, and private businesses, ProTECTOR, Inc. has been able to help drive a small paradigm shift to promote a culture of research on sea turtles within the new administration of the Honduran government, and to encourage the development of public policies based on scientific knowledge and discovery. Most recently, under the leadership of Snr. Rodolfo Pastora de Maria y Campos the Secretary of State from the Office of the President, the research and conservation efforts of ProTECTOR, Inc. have been recognized by the Central Government of Honduras as of value to the country's national biodiversity plans. With direct assistance from the National Department for Biodiversity of Honduras (DiBio) through its Director, Sandy Pereira, ProTECTOR, Inc. continues to work toward the objective of supporting effective conservation activities that help guide a national plan for the implementation of scientific information and the conservation of sea turtles throughout Honduras.

FACTORS ENABLING RESILIENCE OF SEA TURTLE CONSERVATION PARTNERSHIPS IN EL SALVADOR: A CASE STUDY OF HAWKSBILL CONSERVATION IN EL SALVADOR DURING THE COVID-19 PANDEMIC

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Sea turtle conservation projects in El Salvador often are framed as a Community – NGO collaborative process pursuing a set of shared social-ecological goals, for example, improving the livelihoods of coastal communities while recovering sea turtle populations or restoring their habitat. As part of social-ecological systems, these partnerships and stakeholders are vulnerable to external shocks. These shocks are defined as larger environmental or social external forces beyond stakeholders' control and can seriously disrupt or affect them, for example, hurricanes, a major economic crisis, or a pandemic. In order to improve the resilience of conservation partnerships, it is crucial to learn how external shocks affect these systems, how stakeholders cope or react to these shocks, the outcomes, and the hindering or enabling factors mediating these responses and outcomes. In this study, we adopt a naturalist and critical analysis approach to describe how conservation projects reacted to the disruption caused by the Covid 19 pandemic. We present a multiple case study analysis of three sites, Los Cobanos, Bahia de Jiquilisco, and Punta Amapala-Maculís. In these three sites, the conservation NGO ProCosta and local communities partnered in programs to recover the eastern Pacific hawksbill (*Eretmochelys imbricata*). These programs were disrupted by the Covid 19 pandemic. In addition to the public health crisis, governmental measures such as the implementation of an astringent lockdown challenged the livelihood of local communities as well as the regular operation of conservation projects. Despite these challenges, ProCostas and community partners reacted and adapted timely to this new circumstance facilitating the uninterrupted operation of essential conservation activities. In this presentation, we describe the context and adaptation processes of the conservation partnership to respond to the external shocks caused by the pandemic, as well as identify a set of conditions that enabled this response, for example, the strong technical capacity of local communities achieved during the preceding years to the pandemic, a strong trust relationship community' conservation NGO, access to communication technologies, and logistic services, and the capacity of the project to deliver both conservation and social desiraeble outcome through the incentives programs.

*SEA TURTLES STRANDING RESEARCH: A SYSTEMATIC REVIEW

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Stranding events provide opportunistic data that can be invaluable to understand the ecology, behavior, main threats and conservation status of sea turtles. Despite the relatively high cost/benefit, stranding data are often misinterpreted. Research efforts to understand the drivers of sea turtle strandings are still recent; we carried out a systematic literature review to synthesize the state of the knowledge on data sampling method, sampling design, the factors analyzed, and the studies outcomes. *ScienceDirect* was the main

platform for articles' search, with pre-determined stem keywords, which included an established combination ('AND') of: "Sea turtles", AND "Stranding rates", "Stranded events" and "Beaching rates". There were 2842 resulting papers, which were downloaded and filtered by title, abstract and keywords; the remaining 43 articles were retained for full analysis. Regarding the current knowledge, only five articles aimed to comprehend the strandings patterns and rates; the remainder only presented stranding events as a source of biological samples, primarily focused on toxicology and debris ingestion (n = 27). More than 70% of the 43 articles were published after 2010 even though the first was published in 1982; the United States (13) and Brazil (11) were the most studied countries. Concerning the used methods, ~50% of the studies were focused on stranded animals obtained through regular beach monitoring, via stranding networks or hotlines, with a trained team for data sampling. The mean number of strandings was 189.2, and the mean sea turtle species was 2.2. More than 60% of the articles used less than five years of data sampling (range = less than one year to 123 years). The major environmental factors reported as affecting strandings were mean sea surface temperature, current and wind velocity. The most common spatial and temporal scales were tens of kilometers at monthly or weekly averages. The species *Caretta caretta* (26) and *Chelonia mydas* (24) were the most studied, but all seven sea turtle species were recorded in the review. The most frequent outcomes were determinations of population structure and dynamics, with seasonal variations in species behavior. The most important caveats discussed included non-systematic data sampling, which precluded robust analytical approaches and further inferences. This systematic review revealed best practices in terms of methods and analysis concerning strandings events, and highlighted the potential outcomes for species ecology and conservation. However, it also revealed issues to be addressed to improve future studies. Increasing efforts to assess stranding will contribute to developing more robust distribution modelling and clearer threats assessments, which when combined will improve management and conservation planning.

COME TOGETHER! THE EFFECT OF NEST DENSITY ON HATCHING SUCCESS OF OLIVE RIDLEY TURTLES

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Sea turtles are threatened species with a global need for conservation attention. Most sea turtle conservation efforts focus on nesting beaches, where the nests and emerging hatchlings face numerous threats, including poaching, predation, sea level rise, beach erosion, and light pollution. To mitigate these pressures, many conservation projects relocate sea turtle nests to hatcheries. Hatcheries aim to protect nests from these threats by providing a fenced-off environment, away from the high tide lines or rivers. Nests' hatching success in hatcheries - i.e. the proportion of eggs that successfully hatch - depends on many elements, such as nest depth, temperature, moisture, and relocation practices. Nevertheless, current practices guiding global nest relocation efforts are based on standards developed decades ago. For example, a widely implemented practice consists of relocating nests at 1 meter distance from each other, even though there is a lack of empirical data analyzing the effect of the distance between nests in hatcheries on hatching success. Our study evaluates the effect of nest density on the hatching success of relocated Olive Ridley (*Lepidochelys olivacea*) turtle nests. This study was conducted in a hatchery on Piro Beach, in Osa Peninsula (Pacific Southern Coast of Costa Rica). To date, we have relocated 275 wild nests to our hatchery, starting in June 2022, and we will continue relocating nests until December 2022. We relocated nests at 0.5-, 0.65-, and 1-meter distances from its neighboring nest. For hatched nests, we measured the hatching success, and the proportion of eggs infested by bacteria, fungi, maggots, and mites, to assess the effect of nest density on both hatching success and different types of infestations. With our preliminary

results (n = 95), we tested for differences between treatments with a binomial generalized linear model with logit link function. The model showed no significant difference in hatching success between different nest distances (F2=1.2, p=0.32). The mean hatching success of the 0.5-, 0.65-, and 1-meter treatments were 0.67 (± SE 0.08), 0.75 (± SE 0.08), and 0.69 (± SE 0.08). Furthermore, we found no significant differences in the prevalence of infestations between the treatments. Our preliminary results suggest that nests could be relocated at higher density than current protocols prescribe; for example, the hatchery size used in our experiment, 7.3 x 25.5 m, could safely hold 372 nests at .5 m apart vs. 186 nests at 1 m apart. Consequently, more nests per season could be relocated to a hatchery without compromising hatching success, thus increasing their efficiency and the number of protected sea turtle nests globally. These findings indicate that some existing hatchery protocols' recommendations might not maximize its efficacy. Therefore, further research should critically assess the recommendations of hatchery protocols so that sea turtle hatcheries can more effectively protect these threatened species.

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*WARM BEACH, WARMER TURTLES: USING DRONE-MOUNTED THERMAL INFRARED SENSORS TO MONITOR SEA TURTLE NESTING ACTIVITY

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Hundreds of sea turtle conservation and research organizations monitor over 3,200 nesting beaches around the world using traditional methods of patrollers walking for long hours seeking sea turtles and tracks at night. Sometimes on dangerous beaches with drug traffickers, poachers, or feral dogs. The growing area of Conservation Technology brings a new realm to accelerate monitoring efforts and detect illegal activities. Sea turtle programs worldwide have used drones to monitor mass nesting events, reveal adult sex ratios at breeding sites, identify individuals marked with satellite tags, or differentiate species by size. However, all these studies were conducted during daylight. Other projects have used drone-mounted thermal infrared sensors (TIR) to monitor wildlife at night by identifying temperature signatures of animals and their surrounding environment. Nevertheless, to the best of our knowledge, only two sea turtle projects in Mexico and Cape Verde have investigated the potential of TIR drones on nesting beaches at night and only focused on detecting sea turtles and poaching events. Here, we investigate for the first time the effectiveness and potential of TIR drones for night-time monitoring of nesting sea turtles. In September 2021, when the on-the-ground patrollers found a nesting turtle along a transect of 800 meters on Piro beach (Osa Peninsula, Costa Rica), our drone pilot manually flew the drone (Autel Robotics EVO II Dual 8K) 25 m from the turtle. During these preliminary flights, we verified that the drone could effectively detect sea turtles and tracks, hatchlings, nest predators, other wildlife, and poachers at night through thermal differences. We were also able to differentiate between species (olive ridley and green turtles) by the shape of their tracks in the thermal imagery. Moreover, we revealed the optimal parameters for detection by testing different camera gimbal angles, drone heights, and camera visualization modes. Afterward, we flew the drone across seven nights simultaneously and along the same transect where patrollers were surveying the beach to compare the detections by aerial and on-the-ground monitoring methods. Our trials showed that the thermal drone could detect up to 20% more nesting activity than on-the-ground patrollers in addition to 39 other animals/nest predators and three potential poachers that patrollers missed. We also

detailed the challenges and limitations of aerial surveys using thermal drones. These include TIR camera resolution and sensitivity, or the high time invested in analyzing thermal footage. We also suggest potential solutions to overcome these challenges, such as the use of AI to quantify turtles and tracks on thermal footage and offer recommendations for sea turtle programs worldwide to use TIR drones for monitoring and surveillance on nesting beaches. This technology in conjunction with ground patrolling and enforcement by local authorities to convict illicit activities can enhance and accelerate long-term monitoring efforts, research, and protection of nesting females and their nests worldwide.

PROACTIVE CONSERVATION: COMMUNITY-ENGAGED CONSERVATION AND RESEARCH IN DORADO, PUERTO RICO

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Chelonia: Investigación y conservación de tortugas marinas, Puerto Rico, USA

Chelonia: Investigación y Conservación de Tortugas Marinas (CICTM) has been involved in sea turtle research and conservation efforts for more than thirty years. In 2012, the local community of Dorado, Puerto Rico discovered considerable leatherback turtle nesting activity at its beaches. With continuous collaboration with the local community, CICTM has educated students and volunteers of all ages and given field experience and research opportunities to upcoming scientists. During the 2022 leatherback nesting season, daily monitoring consisted of nest and hatching documentation. Community outreach consisted of educational night patrols, post-hatching educational talks during nest census, social media outreach, beach cleanups, and school and event talks. Several research projects--still in process--also took place at PGP as part of daily activities: *Turtle track eDNA*, *Moonlight Influence in Nesting*, *In-nest Temperatures*, *Eggshell Count Comparison: Egg Laying vs. Nest Census*, and *Sand Dune Restoratio*n. Playa Grande El Paraíso (PGP) culminated the 2022 leatherback nesting season with 272 nests, of which 187 were confirmed hatched and with an average hatching success of 69%. Community outreach efforts impacted 7,350 persons through in-person activities and social media. Chelonia aims to continue pursuing science whilst involving the local community as it expands its conservation efforts. The goal of CICTM is to develop its research potential as it promotes conservation and citizen science, and continues its collaboration with the local community.

STRANDINGS OF LEATHERBACK SEA TURTLES, *DERMOCHELYS CORIACEA*, IN SOUTHERN BRAZIL

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Five species of sea turtles use the Brazilian coast as a breeding and feeding area. Among them the leatherback turtle (*Dermochelys coriacea*) which is classified in the Brazilian list of threatened species as critically endangered. On the Rio Grande do Sul state coast (RSC), in southern Brazil, this is the third sea turtle species with the highest number of strandings, with the occurrence of juvenile and adult individuals. This region presents high primary productivity, being an important feeding, development and reproduction area for numerous species of fisheries resources, resulting in an intense fishing activity. In this work, we are describing leatherback sea turtle strandings in RSC. The data were obtained via monthly beach surveys from January 2015 to December 2021 along 355 km of coast, between Lagoa do Peixe (31°20’S/051°05’W) and Chuí (33°45’S/053°22’W). A total of 177 surveys covering more than 24,000

km were conducted along the RSC. For each specimen, we recorded curved carapace length (CCL) and signs of interaction with fisheries, such as entangled nets or ropes. We found a total of 189 dead leatherback turtles, of which almost 50% (n=94) were adults (CCL > 124.7 cm). The highest number of strandings were observed in austral spring (October to December), corresponding to 69% of all records, followed by summer (January to March) with 18%, and autumn (April to June) with 12%. The high number of leatherback strandings is consistent throughout the study period, with a mean stranding rate (number of individuals per 10 km of beach surveys) of 0.079 leatherbacks/10km. In addition, we observed a slight increase in the stranding rate, when compared with a previous work carried out in RSC (1995-2014) that reported a mean of 0.065 individuals/10km. The number of leatherback strandings in RSC is 2.4 times higher than reported from other regions in the south and southeast of Brazil. Between 2015 and 2020, along 822 km of coastline, were reported 78 strandings of leatherback, between the states of Santa Catarina and São Paulo. We recorded for the first time in RSC a recapture of a leatherback from Gabon-Africa. The individual was a female with 170 cm of CCL. This finding corroborates a previous study from genetic origin, using samples of leatherbacks from southern Brazil that showed of 82% of the individuals were from Gabon. Although, only 3.17% of the individuals washed ashore had signs of interaction with fisheries, most of leatherback strandings are probably related to incidental captures in fisheries. In a recent work, from logbooks data, we recorded a bycatch rate of 0.02 leatherbacks/tow in bottom pair trawl fishery. Our results highlight the intensive use of southern Brazilian waters by leatherback sea turtles and confirm the RSC as the region with the highest number of strandings for this species, in the southwestern Atlantic Ocean. Therefore, the creation of marine protected areas in the region and the implementation of management measures for trawl fishing are important to reduce the mortality of this species.

WORKING UNDER FIRE: THE IMPACTS OF A WAR/TERRORISM IN THE TURTLE PROTECTING PROGRAMS IN CABO DELGADO, MOZAMBIQUE

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The terrorist attacks started on 5th October 2017- in Mocimboa da Praia, Cabo Delgado Mozambique. They spread to the northern part of Cabo Delgado. The attack on Palma Town near the Total LNG construction site on March 2021, stopped the gas operation until the present. This war resulted in more than 3000 people died and 817 0000 refugees. Two turtle monitoring programs existed in Cabo Delgado before the war: on a private island, Vamizi island, and another, in Qurimbas National Park. The Oldest green Turtle monitoring project in vamizi island resisted the war and still protecting and monitoring the turtles. The Qurimbas National Park stopped most of the activities and worked in the buffer area of the park which is more peaceful and is near the provincial capital: one nesting beach was discovered in areas that weren't any monitoring before. The consequences of the war in the province are devastating. The monitoring programs struggle to work and to be financed. But marine life seems thriving as the result of fewer people fishing, and fewer markets to sell fish and forbidden turtle products.

THE FISHERS AND SEA TURTLES OF MAJAHUAS BEACH: 38 YEARS OF CONSERVATION IN JALISCO, MEXICO

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In the 1960s and 1970's Mexican fishing cooperatives legally harvested sea turtles with quotas controlled through a federal permit system. Communities that surround the Majahuas estuary, in the municipality of Tomatlán, Jalisco mention that during this period it was possible to observe annual olive ridley arribada events on the Majahuas beach which represents the last 11km of the Playón de Mismaloya sanctuary. The fishers from the Roca Negra fishing cooperative began to observe the decline in sea turtles and in response to the high levels of the harvest of sea turtle clutches decided to begin working for the conservation of these reptiles. To document the fisher's knowledge and memories of the beginnings and progress of this community conservation initiative, we interviewed (N = 20) the members of this organization to record their experiences and stories from more than three decades of work and their views on recent conservation activities and advances being made to continue the project. Fishers mentioned that during the 70s, a small number of fishers decided to erase a large number of sea turtle nests and tracks as well as relocating up to 32 nests per season. This activity was done quietly for fear of being considered informants for which those illegally taking nests could target them. In 1981 the local fishers achieved the legal constitution of their fishing cooperative and decided to continue their sea turtle conservation activities. Fishers mentioned that in 1985 the cooperative received their first federal permit for conservation activities and established a beach hatchery where they protected approximately 500 olive ridley nests during that season. In 1986, the Playón de Mismaloya (Majahuas) was included by the Mexican governments in the announcement of the main sea turtle nesting beaches for conservation. This was a big motivation for the fishing cooperative to continue conservation activities. Following the creation of the National Sea Turtle Protection and Conservation Program in 1990, the fishers received support from a development fund and students from the University of Guadalajara increasing the number of protected nests to 1300 nests. During the first decade of the 21st century, the sea turtle conservation project began to decline, as financial support from government and non-governmental organizations ended and groups that had previously collaborated in beach protection withdrew. Since then, the fishing cooperative has continued conservation activities, but this has been difficult due to lack of funding. Fishers mentioned that they continue because after so long working with sea turtles, something has changed in them and they cannot abandon this work that they consider to be important. They state that lack of funds coupled with artisanal fishing no longer being profitable has resulted in some fishers no longer participating in the project, and others retiring due to age. Despite this, the group continues its efforts to protect sea turtles, and a new local community group has been founded to help support the project and help the fishers continue their work. this resulted in the protection of 7,924 olive ridley nests from 2019 to date.

UNCREWED AERIAL SYSTEMS AS TOOLS FOR GREEN TURTLE POPULATION ASSESSMENT IN COASTAL MARINE PROTECTED AREAS IN URUGUAY

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The green turtle (*Chelonia mydas*) is a highly migratory endangered species. Several direct threat-related strandings of turtles (i.e. bycatch and marine pollution) are reported yearly in the Southwestern Atlantic Ocean (SWAO), and consequently critical areas for sea turtle conservation have been identified in the region, including the coast of Uruguay. This region is an important foraging ground for juveniles feeding on macroalgae, which is a key component of rocky marine ecosystems and provides food and shelter to many species. To date, several efforts have been made to protect sea turtles and reduce threats, however, little attention has been given to evaluating habitat degradation at feeding grounds in SWAO, mainly due to cost and complex logistics. Long-term monitoring programs represent a valuable tool for decision-makers to prevent and mitigate possible threats to sea turtles, and due to their spatially complex life cycle and biology, research and conservation efforts for these animals have been relying on new technology and more efficient protocols to achieve a better understanding of population trends and threats. Recently, Uncrewed Aerial Systems (UAS, or drones) have been introduced for such studies. However, their implementation has been neglected in the SWAO, due in part to the limited sampling protocols available and low water visibility. This project is part of our development of a holistic approach to the conservation of the green turtle and its coastal habitats in the region. For the first phase we used a UAS to survey juvenile green turtles in Cerro Verde e Islas de la Coronilla Coastal-Marine Protected Area (CMPA), Uruguay. We conducted aerial surveys over the water during December 2021 and from January to May 2022. We deployed the UAS from the shore, collecting video of the coastal foraging grounds while flying 200m linear transects at an altitude of 35 - 40 m. We conducted a total of 123 missions in four survey areas over 25 field days. Mission duration depended on the survey area and flight times ranged from 7 to 16 minutes, totaling 20.4 hours of video. Days in the field were limited due to high wind and Beaufort Sea State, with operations only possible at mean wind speeds below 28kph (max gusts of 35kph) and sea state of 3. Depending on the survey area, we counted 0 – 14 turtle sightings for the lower count missions and 35 – 126 sightings on the higher count missions. These results are preliminary and additional videos are being processed. The next step will be to analyze the data with DISTANCE 7.5 to obtain a relative abundance estimate of juvenile green turtles in CMPA. This ongoing work demonstrates that UAS are effective tools for performing sea turtle monitoring in a region that was previously understudied due to environmental factors such as water clarity.

NATURE-BASED AND SCIENTIFIC TOURISM AS INSTRUMENTS FOR THE CONSERVATION OF SEA TURTLES IN THE URABÁ-DARIÉN, COLOMBIAN CARIBBEAN

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Sea turtle observation is considered a strategic activity to conserve these species since it raises awareness of people while generating economical resources to support conservation programs and the local community. All around the world, several communities protect sea turtles, nests, and hatchlings, such as the case of Bobalito, an important nesting beach located in the Colombian Caribbean. The success of sea turtle observation as a conservation strategy depends on the availability of specific information on sea turtle populations and the nesting beach and the existence of a touristic offer designed to respond to the needs of the area. For this reason, this work aimed to propose responsible tourism experiences that contribute to the sustainable development of the local community. From primary and secondary sources, the resources and tourist attractions of Lechugal village were identified, to propose experiences of nature-based tourism and scientific tourism. Later, pilot tests with handmade oceanographic instruments were carried out. As a result, Cerro del Águila and Bobalito beach were defined as tourist attractions, where sea turtles sighting and training were included. In sum, eight tourist activities (four of nature tourism and four of scientific tourism) were designed based on the conservation and recognition of the coastal heritage. In general conclusion, the growing tourism development on the Antioquia coast should be used for the conservation of sea turtles. Therefore, the creation and implementation of nature-based tourism and scientific tourism could be considered an economical solution for the Lechugal community, in the sense that it allows reconciling low-pressure development with the preservation of threatened species.

MODELING SDGS IN SEA TURTLE CONSERVATION THROUGH LOCAL COMMUNITY INVOLVEMENT. A SUCCESSFUL HISTORY FROM PACUARE RESERVE, CARIBBEAN OF COSTA RICA

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Sea turtles are some of the most charismatic and ancient creatures on the planet. They play an important role in a variety of marine ecosystems, are often used as a barometer for environmental health, and serve as an iconic species for the protection of our vast oceans. But, after more than 100 million years of existence, sea turtles are experiencing an even more rapid rate of decline in the current Anthropocene than was observed during the Cretaceous-Paleogene. Currently there are seven species of sea turtles in existence, and their global conservation statuses, as defined by the IUCN Red List, are not very encouraging, all of them are threated of extinction. Over the last 200 years, human activities have been largely responsible for the decimation of these species—by overharvesting sea turtle eggs and meat, overexploiting skin, and shells, and disrupting or destroying nesting habitats with development. Climate change is also now affecting their survival rate, as habitats critical for sea turtle nesting, migration, and feeding are becoming unsuitable. In addition, sand temperatures are rising in many areas, affecting the survival of embryos, and altering the sex ratios of the hatchlings. From national governments to local

communities, a massive variety of conservation initiatives have been employed, many attempting to define best practices that protect sea turtles while providing socioeconomic alternatives to harvest or exploitation by the humans who live alongside them. Yet all sea turtle species are declining faster than ever in all regions of the world. The 2030 Sustainable Development Goals (SDG) are incredibly important for the future of our planet, for the global economy, and human society. The 17 goals are further broken down into 169 targets and 231 indicators—which could be a complex agenda, but all goals are interlinked, indivisible, and must be approached as a group to get results. Sea turtle conservation programs and initiatives must follow a similar path—finding how to mitigate the biggest threats by seeking comprehensive actions and collaborative efforts among scientists, civil society, and governmental entities. Every country needs to define the best way to approach the implementation of its national sustainable development strategy, and it needs to include a general public who care about the populations of sea turtles as part of these efforts. Since 1989, Pacuare Reserve, a 2,000-acre recovering rainforest with 3.7 miles of Caribbean beachfront, and administrators have been working diligently to protect the sea turtles who nest on its beaches, and their eggs and hatchlings. However, unlike many reserves, Pacuare Reserve actively engages the local community in its wildlife research and conservation initiatives—never forgetting about the needs of the community and creating socioeconomic alternatives to the harvest or exploitation of sea turtles. In 1989, the illegal harvest rate of sea turtle eggs was 99% at Pacuare Reserve--today, that rate is only 0.7%, thanks to these educational engagements. In addition, Pacuare Reserve has provided a place for the study of climate change on sea turtles and associated novel methods of conservation.

PANAMANIAN NACIONAL SEA TURTLE CONSERVATION NETWORK

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The Republic of Panama is located in Central America; bordered to the north by the Caribbean Sea and to the south by the Pacific Ocean; in both seas, there are numerous nesting beaches, feeding sites, and migratory corridors for five species of sea turtles; Olive ridley (*Lepidochelys olivacea*), Hawksbill (*Eretmochelys imbricata*), Leatherback (*Dermochelys coriacea*), Green turtle (*Chelonia mydas*) and Loggerhead (*Caretta caretta*). There has been a long history of using sea turtles in Panama for decades for consumption, trade, and/or subsistence, which has drastically reduced sea turtle populations on both coasts. Most conservation programs are carried out on nesting beaches, and most are community-based. In the interest of forming alliances between community conservation groups, local and international organizations, universities, and government authorities, the "PANAMA SEA TURTLE CONSERVATION NETWORK (PANATORTUGAS)" was created. With the objective of consolidating the efforts of organizations working towards the recovery of sea turtle populations in Panama. The PANATORTUGAS Network was formally established in October 2016 to promote the conservation and protection of Panama's sea turtles; it is made up of 17 Panamanian organizations: 5 in the Caribbean and 12 in the Pacific; each organization protects and conserves its own nesting beaches and promotes environmental education programs in their communities. PANATORTUGAS has a Board of Directors and a Technical Committee which all work "*Ad Honórem*", to date we have not achieved legal status due to lack of funds. Since 2017 we have a website founded by private donations and a volunteer designer, in addition to social networks Instagram and Facebook managed by our Secretary. PANATORTUGAS achieves its objective through close collaboration with coastal communities, scientists, politicians, and authorities throughout the region. Six (6) General Assemblies have been held in which each organization presents the results of their projects (registered in our database), in addition, there have been more than 20 training workshops that strengthen information sharing, awareness raising, research, environmental education programs and conservation initiation that can be applied among the different groups which are part of PANATORTUGAS. We actively have participated in promoting the creation of agreements, laws, and other regulations for the conservation of sea turtles in Panama, for example, we were the creators of the legislative initiative that resulted in the creation of the Draft Bill, "Establishing the Conservation and Protection of Sea Turtles in the Republic of Panama"; recently the full Bill was approved on a third debate in Congress. This Bill is called Bill # 614, which establishes the Conservation and Protection of Sea Turtles and their habitats in the Republic of Panama.

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*REGIONAL ACTION PLAN FOR NORTHWEST ATLANTIC LEATHERBACK SEA TURTLES, *DERMOCHELYS CORIACEA*, IN THE WIDER CARIBBEAN REGION

Soraya Wijntuin

WWF-Guianas, Suriname

The endangered Northwest Atlantic (NWA) leatherback sea turtle (*Dermochelys coriacea*) subpopulation ranges throughout the northern Atlantic Ocean. Major nesting areas occur in the Wider Caribbean Region in Trinidad and Tobago (TT) and the Guianas (Suriname, Guyana, and French Guiana), and primary foraging areas that extend from the equator north into in Atlantic Canada and United States of America (USA). Due to the significant decline of the NWA leatherback on major nesting beaches, it was identified that urgent and immediate action was needed on a regional scale. This resulted in the Regional Action Plan (RAP) for the NWA Leatherback Sea Turtle project. The goal of the RAP is that by 2030 the biggest threats responsible for the decline of the Northwest Atlantic leatherback sea turtle Guianas and Trinidad and Tobago subpopulation have been identified and necessary action has been taken to stabilize and revert the population decline. The RAP is unique because of the participatory approach by engaging and involving the key stakeholders such as government agencies, indigenous communities, fishing folk, academia, NGOs and sea turtle experts on national level and regional level and by having the support and expertise of the regional sea turtle organization WIDECAST (Wider Caribbean Sea Turtle Conservation Network). Since 2020, the RAP development has been led by WWF-Guianas (Suriname and Guyana) with working group representatives of partner organizations the Environmental Management Authority (EMA) in Trinidad and Tobago, Office français de la biodiversité / French Biodiversity Agency (OFB), and WWF-France in French Guiana, WIDECAST, WWF-Canada, and WWF-Netherlands. With a focus on the Guianas and TT nesting populations key stakeholders throughout the Wider Caribbean Region, provided input and defined priority actions and specific activities to address causal factors in the recorded recent decade decline of this subpopulation, and identified foraging areas and migration routes. It provides specific guidelines towards increasing community engagement and improved legislation at the local level, which combined with access to better scientific knowledge will support and enhance the positive impact of improved practices for the protection and management of critical habitats. In addition to this, the RAP outlines the required structure for governance and funding. The RAP was finalized in June 2022, and it is available in English, Dutch, Spanish and French. From mid-2022 to mid-2023, the focus of the RAP will be to implement priority actions to mitigate human threats to the Guianas and TT leatherback sea turtle subpopulation, in which as part of the governance structure, a governing body is currently being established for the region to aid implementation of RAP actions. Simultaneously, a 5-year proposal including a work plan with stakeholder roles and responsibilities per country outlined, is being developed with partners of the region to ensure the full implementation of the RAP. Here we present on the current knowledge and status of the NWA leatherback sea turtle and the RAP progress. Help us in bringing this RAP on relevant national and regional agendas, because we must take action now to save our NWA leatherbacks.

*SHOULD HEAD-STARTING BE IN THE CONSERVATION TOOLBOX FOR SEA TURTLES?

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Head-starting is a conservation tool for a wide range of animals, where early-life history stages (such as hatchlings) are reared in captivity and released at larger sizes in an attempt to increase survivorship. It is commonly used in the management of long-lived and late-maturing freshwater turtles and tortoises, with many case-studies showing beneficial conservation outcomes. Head-starting has been used, and continues to be used, as a management tool for the conservation of sea turtles. However, it has been difficult to assess the conservation benefit of sea turtle head-starting programs. Here, we outline key case-studies of head-starting and highlight common reasons why conservation benefits have been difficult to determine. Furthermore, we propose recommendations for current or future head-starting programs that aim to have a conservation benefit. Specifically, that; a) head-starting programs should only be initiated if their conservation benefit can be measured; b) studies should investigate population dynamics, particularly of early-life history stages, in specific and feasibly-sized populations to establish baseline survivorship estimates; and c) simultaneously, within these specific populations, the impact of captive rearing and release on population dynamics should be assessed. Recent technological advances, in areas such as biologging and genetic fingerprinting, should enable more efficient assessment of head-starting programs, and in time, could reduce uncertainty regarding their conservation benefit.

*SHARING THE SUCCESSES: FIFTEEN YEARS SINCE REDISCOVERY OF HAWKSBILL TURTLES IN THE EASTERN PACIFIC OCEAN

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ICAPO, USA

Back in 2007, the outlook for hawksbill turtles in the Eastern Pacific Ocean was grim and the population was widely considered extirpated in the region. At that time there were no records of any consistent nesting beaches along the approximate 15,000 km of potential habitat along the Pacific coast of the Americas. There was not even a record of a nesting beach where five nests were recorded each year. Scattered anecdotal reports by fishermen who reported seeing small hawksbills would surface on occasion, with fishers recognizing the juveniles due to the characteristic serrated edge of their carapace. Faced with the lack of information on the species, a directed search was undertaken to confirm one of two outcomes: 1) indeed the hawksbill turtle had been extirpated in the Eastern Pacific, or 2) there were still hawksbill hotspots, and thus hope for the future of the population. In January 2008, a small team began exploring northwest Mexico in search of hawksbills and relying on reports of local fishermen, they encountered dozens of juveniles of the species. Given that success, the next step was to bring together turtle researchers in the region (USA, Mexico, Central America, South America) at the 28th international sea turtle symposium in Loreto, Mexico. The group held and informal meeting over breakfast, and that is where the Eastern Pacific Hawksbill Initiative (ICAPO) began. That meeting, and subsequent research and collaborations, led to the discovery of several important nesting and foraging areas throughout the Eastern Pacific. In this presentation we will share what has been achieved in fifteen years of research and conservation of hawksbills in the Eastern Pacific, including an overview of the many sites that have been discovered, the nest protection and in-water projects that have emerged, and the individuals and

organizations that have led these efforts, which combined provide hope for the future of the population. Most of the primary conservation measures for nesting hawksbills in Eastern Pacific have been consistent since their inception and remain functioning at present time. We suspect that the hatchlings protected and released via those efforts will soon be returning to their natal beaches as adults to lay eggs, and thus we expect to see an increase in the annual number of nesting females in the coming years. There are many successful stories of sea turtle population recoveries and increased in many parts of the world and we are optimistic hawksbill turtles in the Eastern Pacific will join the ranks.

EDUCATION, OUTREACH AND ADVOCACY

*INNOVATIVE EDUCATIONAL METHODS FOR RAISING AWARENESS ABOUT SEA TURTLES AND DEVELOPING STANDARDIZED MONITORING PROTOCOLS: A PILOT PROJECT USING THE ADDIE MODEL IN PACIFIC NICARAGUA

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Anthropogenic factors increasingly jeopardize sea turtles and their habitats. Specifically, in Nicaragua, sea turtles are threatened by the consumption of sea turtle eggs and meat, coastal development, rising sea level, and pollution. In 2019, *the Fabien Cousteau Ocean Learning Center (FCOLC)* initiated the Sea Turtle Conservation and Women Empowerment Program. The FCOLC supports and facilitates the program in close collaboration with the local community and Sutiaba indigenous peoples. The program aims to protect the local nesting population of sea turtles and their hatchlings, promote the conservation of natural resources, and empower local women. The current monitoring program is based on a three-year effort that began during the pandemic. In 2022, the program focused on developing the Train-the-Trainer (ToT) initiative with the goal of implementing best management practices (BMPs) for monitoring nesting sea turtles in the region. The program’s pilot project was conducted in Leon, Nicaragua, from October to November 2022. The methodology used included the A-D-D-I-E model to Assess, Design, Develop, Implement and Evaluate, as well as the 12-step needs assessment. The project deliverables were: 1) content development for a ToT workshop to standardized monitoring and tagging protocols for nesting sea turtles, 2) the evaluation of knowledge gained by ToT workshop participants, and 3) an assessment of the delivery of the ToT workshop. The first step in the ADDIE model was to conduct a literature review using specific keywords to search the University of Miami's library database and grey literature via Google Scholar spanning a ~23-year period. The search revealed 12 documents with general monitoring protocols, two were specific to the region, and one was specific to Nicaragua's Pacific coast. From these documents, the material for the ToT workshop was developed to pilot test protocols to identify best practices (BMPs) for content and delivery of the training. Workshop training material consisted of a PowerPoint presentation about sea turtles and monitoring, a pre/post quiz to measure participant comprehension, and a training survey to assess the usefulness of workshop content and delivery. The pilot project's preliminary results revealed that modifications to the monitoring protocols could be improved in both administration and the content. The presentation of the material for the ToT workshop can be improved with a clear outline of activities, materials needed, and assessments (e.g., process agenda). Additionally, the results indicated that a two-day workshop format is preferred to allow sufficient time to review the training material, datasheet, and practical experience. Content improvements were made by adding additional visuals, videos, team member roles/responsibilities, and hands-on field activities to reinforce classroom lessons. This pilot project emphasizes the unique circumstances and capabilities of individual communities and the need to match the content and delivery accordingly. Standardized monitoring and tagging protocols may help improve the collective understanding of regional sea turtle population trends by developing a baseline for monitoring protocols and informing stakeholders about possible factors affecting sea turtle population status and health.

*PRESERVING HAITI'S ENDANGERED SEA TURTLE POPULATIONS THROUGH COMMUNITY-BASED EDUCATION AND OUTREACH INITIATIVES

Jamie Aquino, Francklin Barbier, Claude Pressoir, Charlens Calixte, Cleeford Joseph, Myson Samedi, Courtney Vail, and Annabelle Brooks

Haiti Ocean Project

The Caribbean country of Haiti is home to four confirmed sea turtle populations: hawksbill, green, leatherback, and loggerhead. They face numerous threats including direct harvest, incidental bycatch, and marine debris. The threat of extinction in Haiti is amplified by the lack of awareness about these species by the local communities, who, due to lack of resources and instability across the country, see these valuable marine species as a food source. Public education and conservation-based outreach are critical to highlight this problem on a local level in the rural areas of the country. Since 2007, Haiti Ocean Project has been working to educate coastal communities along the southern peninsula, to change the cultural perspectives on sea turtles in Haiti. This initiative involves education and outreach to the entire community, including fishers, youth, women, and local leaders. Workshops are organized to share information and discuss ways to save these endangered sea turtles. Educational programs are developed to teach about sea turtle biology, conservation, and their value in an ecosystem. To reach all ages and education levels, printed materials are developed for young children, youth, and adults and translated into Creole, the native language of Haiti. To further engage the locals, activities are developed to give all who are interested a chance to observe sea turtle habitats, help with the rescue and release of sea turtles and clean up potential sea turtle nesting beaches. Extending the knowledge of Haiti's sea turtle populations will better inform Haitians how to protect turtles and their habitats, thus giving these valuable endangered species a chance for survival in Haitian waters.

THE INDIGENOUS COMMUNITY OF PLAYA CHIRIQUÍ AND THE CONSERVATION OF CRITICALLY ENDANGERED SEA TURTLES

Felipe Baker, Cristina Ordoñez, and Raúl García-Varela

Sea Turtle Conservancy

Since its founding in 1959, The Sea Turtle Conservancy (STC) has worked in several parts of the world, in Panama started its work in 2003 at Playa Chiriquí. Archie Carr described this beach as one of the most important for hawksbill sea turtle nesting in the Caribbean. Hawksbill nesting in Chiriquí experienced a dramatic decline estimated up to 98% from 1980 to 1990 due to international trade. The STC goals from 2003 to the present have a joint approach with the local community, starting from intensive monitoring of the nesting Hawksbill and Leatherback females and environmental education directed to the local school students. The results of that work have allowed for building a solid link with the local community for inclusion in fieldwork, talks, and outdoor activities, as well as the experience of young people through the youth assistants program, where students go to the beach to have experience on sea turtle biology. As a result, it has been possible to see a gradual recovery of the nesting population with a range of over 1,000 hawksbill turtle nests per season compared to critical numbers before 2003, and community commitments to sea turtle conservation is a guarantee of the success of the project. Environmental Education has been strengthened thanks to the growing interest and influence of the teachers from the local school; this community is taken as a reference for conservation models with the scientific community and professional trainers inspired by the relationship between STC and the community itself. In conclusion, the role of the Ngäbe-Bugle indigenous community in Playa Chiriquí has been fundamental for the survival of sea turtles due to their previous initiatives and active participation in conserving them through the years of work together with STC. The indigenous communities live together with valuable natural resources; for that reason, they are critical actors in conservation efforts to work as a team and carry out conservation efforts that are better guaranteed.

CITIZEN SCIENCE TO THE RESCUE OF THE SEA TURTLE NESTING POPULATIONS OF HERMOSA BEACH, UVITA DE OSA, PUNTARENAS, COSTA RICA

Oscar Brenes Arias

Reserva Playa Tortuga, Costa Rica

Hermosa Beach is a nesting site located on the South Pacific coast of Costa Rica before the year 2020 no formal research was conducted on this beach. For that reason, Reserva Playa Tortuga had the plan to establish a sea turtle nesting monitoring program on Hermosa beach, but the pandemic of SARS-CoV-2 affected sea turtle conservation programs worldwide, with a lack of international volunteers and funding, resulting in their operation, difficult or impossible to continue. In the midst of the pandemic, our region experienced an influx of individuals from North America and Europe interested in the country's nature and conservation efforts, by identifying that opportunity, Reserva Playa Tortuga organized an open community meeting to encourage Costa Ricans and ex-pats to become volunteers for the protection of the Hermosa beach turtle nesting area. In June 2020, Reserva Playa Tortuga created the first group of local volunteers, integrated by community members, lifeguards, and rangers. All the participants received training in sea turtle nest management on the beach and in the hatchery, led by the organization's research team. The local volunteers were organized in groups of a minimum of three people per day and the beach was monitored by each team, every morning starting at 4:00 am. In the first month, the Reserva Playa Tortuga research team joined every walk to teach the scientific protocol in the field, and once the volunteers got experience, they started to go without the biologist. The data collected for every turtle nesting evidence was by using a cellphone, data recorded by the volunteers were, time, date, event location, nest (effective, no effective or poached), false crawl, track width, species, and turtle biometry (LCC, WCC). The eggs for each nest were taken by the volunteers and relocated to the turtle hatchery of the organization. The volunteers received remote assistance from the biologist through video calls, photos, and videos, when they were in the field, to clarify any doubt about the process or species. As a result of the first season monitoring at Hermosa beach, from July 15th, 2020, to February 15th, 2021, a total of ninety-seven nesting events were recorded, seventy-seven were from *Lepidochelys olivacea* and ten from the *Chelonia mydas.* Fifty-seven of the total events were nests of the Olive ridley and five from green/black sea turtle. By the end of the 2020-2021 season, a total of 3901 hatchlings of *L. olivacea* and 217 of *C. mydas* were released, resulting in 86% and 95% of recruitment success for each of the species. Thanks to the monitoring effort conducted by the local volunteers during 2020-2021, the poachers stopped walking in the mornings opening the possibility of rescuing more nests in the next seasons. The site was reconfirmed by the Sea Turtles Costa Rican authorities as an Olive Ridley nesting area, and it was possible to report the first official nesting event of a Pacific green turtle for Hermosa Beach.

INITIAL RESULTS OF THE RAPID NESTING AND THREATS ASSESSMENT FOR THE RECOVERY OF HAWKSBILL NESTING IN THE GULF OF THAILAND

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Sea turtles in Thailand have declined precipitously since the 1970s despite government efforts to establish protected areas and management strategies. In recent decades, several small, disconnected surveys were initiated to improve conservation efforts. In 1998, WWF Thailand recommended a national program of nesting recovery and beach protection in place of head-starting programs. However, efforts to establish a nesting recovery plan were minimal. The problem of declining nesting activity in Thailand is especially pronounced for hawksbill turtles. Turtles are caught as bycatch in the Gulf of Thailand (GoT), and shell products were once traded in national markets, contributing to vigorous trade in tortoiseshell throughout Southeast Asia. We stressed the immediate need for a current rapid assessment for nesting turtles that could provide a reference for community development of a nesting recovery network supporting local and national conservation throughout the GoT. Between July, 2018 and April, 2019, we surveyed 141 beach locations along more than 833 km of GoT coastline to assess sea turtle nesting, and interviewed community members and government officials for awareness of nesting activities along these sites. In addition, we located and mapped at least five sites with observed hawksbill nesting, with evidence for green turtle nesting, and one site with leatherback nesting. We also investigated and mapped local community public markets, private shops, and restaurants for the sale of hawksbill shell, eggs, and meat. Additionally, a team of Thailand representatives attended the Southeast Asia Turtle Training Workshop in Kep, Cambodia from 29 October – 02 November, 2018, then provided presentations for Thai nationals at the first Thailand National Sea Turtle Training Workshop held 20 – 21, November, 2019. A major goal of the project is community outreach and education through beach monitoring workshops. In 2019 we held one area workshop on Koh Talu, and in 2022, we held two education workshops on the eastern side of the GoT, and three on the western side. In total to date, more than150 community members and government agents have been trained in turtle species identification by sight and by beach tracks during the day and night, learned to record nesting activities, nest locations, tag numbers, and measurement data, and collect photographs for photo-ID. As a result of the current USFWS-MTCF-supported rapid assessment project, there is growing interest by local communities and provincial officers from the Department of Marine and Coastal Resources, the Royal Thai Navy, and the Department of National Parks to continue further education of community members and the development of an outreach program aimed at school-aged children in both coastal and inland communities. This project aims to link government officials with community members through a network of hands-on training and beach monitoring education to improve the state of hawksbill nesting, beach monitoring, and reporting of turtles throughout the GoT.

INNOVATIVE EDUCATION TO SUPPORT AND PROTECT SEA TURTLES: FROM CLASSROOMS TO CRYPTOCURRENCIES

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The survival of sea turtles depends largely on reducing anthropogenic factors negatively affecting the species' life cycle. Reducing anthropogenic effects may be accomplished through environmental education, but it also requires funding support. Since 2018, the Fabien Cousteau Ocean Learning Center (FCOLC) Sea Turtle Conservation and Women Empowerment Program has sought to build the human-ocean connection through educational programming for a variety of audiences, including both students and financial donors. The FCOLC is using a two-pronged approach to create innovative educational programming in support of sea turtle conservation through science-based education and storytelling for social impact investing. FCOLC consultants and volunteers evaluated various forms of environmental education products to promote conservation and garner funding support using the ADDIE model to Assess – Design – Develop – Implement – Evaluate to identify outcome-driven results. Two innovative educational concepts were identified: 1) science-based environmental education for classroom and field experiences for underrepresented students and community members, and 2) storytelling to educate social impact investors about sea turtle conservation through a variety of donor methods ranging from cash to cryptocurrency. Science-based environmental education for students and communities The FCOLC in partnership with the National Autonomous University of Nicaragua oversee the sea turtle program and promote student learning in biological and survey research in classrooms. Biological research includes nesting and hatchling sea turtle data collection and analysis. Survey research includes developing and assessing train-the-trainer content following the University of Miami's Institutional Review Board Human Subjects Research protocols. Innovative aspects of educational programing include collaborative experiential learning between Nicaraguan students, local women and girls, local tour guides and egg collectors, and students and volunteers from the United States. Storytelling for social impact investors Storytelling can be powerful and inspire conservation by sharing cultural worlds through the imagination of listeners. The Sea Turtle Conservation and Women Empowerment Program is locally managed and operated by women and girls. The project team gathers science-based information about sea turtles and support one another both personally and professionally. Stories about the team members, and the impact not only to sea turtle conservation, but on their lives is being captured to share with donors and investors. *A Day In The Life* was written for social impact investors to envision the daily activities of the project lead, Aracely, as she guides the day-to-day activities of the sea turtle conservation program and interacts with her family, turtle team, and the community. The story illustrates the connection between her life and the precious ecosystem around her – including both humans and the environment. Storytelling is one example of innovative education the FCOLC is using to educate investors and financial managers about ocean conservation with *A Day In The Life* helping to explain to how donations and investments can make a difference in the lives of those who seek to conserve, protect, and restore biodiversity.

DIVING CENTERS AS A KEY LINK FOR REPORTS OF SEA TURTLE SIGHTINGS

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The Colombian Caribbean has the environmental conditions to have sighting records of 6 of the 7 species of sea turtles present around the world. Department of Magdalena belonging to this region which has protected marine areas within the Tayrona National Natural Park that allow the presence of four of these species, and are also areas of abundant diversity of species and tourist attractions including being an important spot for recreational scuba diving. The objective of this research was to identify the sightings of sea turtles in the areas where diving activities are carried out more frequently or in close areas, besides to encourage the participation of diving centers to report the specimens observed being part of the citizen science methodology. For this, personnel from the diving schools were trained in the identification of the different species of sea turtles, the threats to which they are exposed, general aspects of their biology and ecology, as well as the correct way to collect essential information for reports. of sightings. 20 diving schools were visited in The Rodadero, Santa Marta and Taganga areas, which provided information about the number of sightings, state of the organisms, sizes and even the most common species in frequent areas; In addition, a collection of photographic records and videos of sea turtles seen in the sea in recent years was collected, with which it is hoped to carry out photo identification of the specimens. As part of the fieldwork, informative resources were delivered, including a poster and an identification guide describing the main species that reside or arrive in the region, in order to encourage the community to recognize the species and contribute to the conservation of these retiles. In the information collected with the surveys, it was found that more adult sea turtles have been seen in previous years than in the current year and the frequency of sightings varies according to the climatic season. On the other hand, the most common turtle species is the green turtle (*Chelonia mydas*) followed by the hawksbill (*Eretmochelys imbricata*) and the loggerhead (*Caretta caretta*). The information collected is an important input to contribute to the knowledge of the current status of sea turtles in the department of Magdalena, and thus help in the implementation of management and conservation plans.

*GROWING THE SEA TURTLE WEEK CAMPAIGN TO RAISE AWARENESS

Bethany Holtz, Brad Nahill, and Paula Von Weller

SEE Turtles, USA

Since 2019, SEE Turtles has coordinated the worldwide community of sea turtle organizations and researchers during Sea Turtle Week to educate the public and celebrate all things sea turtles. The week spans World Oceans Day (June 8th) to World Sea Turtle Day (June 16th), with each day in between highlighting a different species and the primary threats that sea turtles face. More than 170 sea turtle and environmental organization in 45 countries participate as partners in Sea Turtle Week each year. With 4 years of programing, Sea Turtle Week has doubled from an initial online audience of 4 million individuals to more than 8 million annual viewers. In 2022, we reached at least 8.1 million users, saw 2,500+ posts using the #SeaTurtleWeek hashtag, had 6,500 visitors to our website, and engaged 110,000 individuals. This growth has consisted largely of an online effort on social media along with the Sea Turtle Week website (seaturtleweek.org) and branded graphics. Between our three social media channels, Twitter, Instagram, and Facebook, we have 7,526 followers with numbers growing every month. During the remainder of the year, the Sea Turtle Week social media channels serve as an educational outlet, sharing

current news articles and events, highlighting partners, and featuring a weekly #SeaTurtleScientistSaturday. As the fifth anniversary of Sea Turtle Week scheduled for 2023, a schedule of new events and assets are planned that will take Sea Turtle Week from an online program to an on the ground event. Events including a children's art contest, photography contest, global beach cleanup, and a YouTube shorts series are proposed for 2023 to expand our audience to new demographics. Our goal is to boost engagement by the general public, as well as to inspire sea turtle organizations to hold annual educational events. With a reach of more than 25 million total users over the past 4 years, Sea Turtle Week has the potential to inspire a new wave of sea turtle enthusiasts around the world.

COLLABORATIVE WORK WITH FISHERS: A FUNDAMENTAL TOOL FOR SEA TURTLE CONSERVATION IN ARGENTINA

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Argentina corresponds to the southernmost feeding and development area in the Southwest Atlantic for three species of sea turtles (*Caretta caretta*, *Chelonia mydas*, *Dermochelys coriacea*). The areas with high amounts of food for these species coincide with great anthropic pressure sites. This is because the oceanographic conditions of the zone favor the development of different fishing stocks, transforming them into important fishing grounds in the region. Although there are bycatch reports of these species in different fishing gears, the magnitude of the problem is unknown to date, given that the interactions occur in coastal vessels without observers on board. The goal of this work is to encourage the participation of the fishing sector in sea turtle conservation, to train them in species identification, and to involve them in the joint development for collaborative solutions for sea turtle good handling practices on-board. Between October 2021 and June 2022, an outreach campaign was carried out in five important fishing sites in the province of Buenos Aires, where: (1) Identification sheets of species with a clear and simple design to be carried on board were handed out to vessels, and fishers were trained in species identification; (2) educational posters with general information on sea turtles were distributed in key places (port facilities, headquarters of Prefectura Naval Argentina, National Fishing School, etc.); (3) the graphic material was given to fisheries inspectors and made public on the official website of the Ministry of Agriculture, Livestock and Fisheries of the Nation to facilitate compliance with Resolution SAGYP 92/2021, which consists of reporting marine fauna bycatch in fishing reports; (4) Five workshops were held, attended by people from the fishing sector (captains, sailors, port and government authorities) to address the problems associated with the activity and the sea turtle good handling practices on-board. Collaborative work with fishers is a fundamental tool that not only broadens knowledge of a potential problem in the region, but also promotes favorable attitudes towards conservation actions for marine fauna. Graphic material was widely accepted by the crew, which was reflected in the fact that the identification sheets of species were hung on their vessels, and also in their good predisposition to join in the conservation actions. The outreach campaigns and workshops have been a good opportunity to talk to the fishers and learn about the current actions taken with sea turtles on board. This allowed us to identify, prioritize and start working on those practices that need to be modified in order to increase the number of live turtles released into the sea. With all this knowledge we developed a good handling practices sheet with correct ways to proceed, actions to avoid, and the reasons why they should be avoided. These will be distributed in 2023 to be carried on board of vessels, together with the species identification sheets. With this we hope to continue to the guidelines of the National Action Plan for the Conservation of Sea Turtles in Argentina to improve good fishing practices and reduce sea turtle mortality.

THE ENGAGEMENT OF THE COMMUNITY FOR SEA TURTLE CONSERVATION

George A. Miller, Monica Panachão, Rodrigo G. P. Lopez, and Damiana C. F. Pimenta

Iniciativa de Ciência Cidadã Coração de Tartaruga

Coração de Tartaruga (CdT) was created in 2019 in an effort to understand how sea turtles use the beaches of the Peninsula de Maraú, Bahia and, consequently, to help with their conservation. Embracing the concept of citizen science, CdT motivates the community to participate, as volunteers, in the sea turtle conservation actions by collecting relevant information such as: sighting of tracks, nests and hatchlings, stranding of animals and illegal fishing. This data is submitted by CdT to the national government database of TAMAR Center - ICMBio (Chico Mendes Institute of Biodiversity). As a result of the community's help, we currently monitor 42 km of beaches. Through field work training, an essential element of citizen science, we offer basic knowledge about sea turtles and data collection to the volunteers. This educational aspect of our initiative has shown growth in engaging the community in the protection of sea turtles and their nesting grounds in our region. We also offer Ocean Literacy at a local community school as a pilot program. Recognizing the importance of broadening awareness and having information displayed at all times, with the financial support of the Fundação Grupo Boticário and the endorsement of the local community, municipal Secretaries of Tourism, Education, and Environment, CdT is currently creating seven Ocean Literacy Stations- OLS. Each of these stations will contain a visual display composed of 4 panels that will be installed in seven main tourist locations in the Península de Maraú. These panels will form a self-guided educational route that will take residents, tourists, and visitors on a journey to learn about: 1) the seven principles of ocean literacy, 2) the world's seven species of sea turtles, 3) the ecosystems of Maraú and 4) tips for responsible tourism. Moreover, a web-based app is being designed to connect the general public to these main points of information to encourage the visitation of the seven OLS by providing the construction of a knowledge trail about the Ocean. With semi-deserted beaches and low population occupancy, the involvement of the community in the collection of data and the education of tourists and residents have been crucial for the sustainability and improvement of the conservation actions carried out by CdT. As a result, after 3 years of continuous monitoring, we have collected scientific data to show that we have a regular reproduction area, with the presence, on average, of 230 nests per nesting season. We have also found that Maraú receives 4 of the 5 species of sea turtles that occur in Brazil, with the highest number being the species *Caretta caretta* followed by *Eretmochelys imbricata*. Thanks to these actions, we expect a change in the conservation status category of this region soon from sporadic to a regular nesting site. This change will ensure that the existing federal legislation for the protection of sea turtles will be enforced in this region, thus increasing the chances for the recovery of sea turtle populations.

*AMIGOS DE LAS TORTUGAS: USING PARTNERSHIPS TO BRING TOGETHER COMMUNITIES IN NEED

Rebecca Mott[1] and Yvette Fernandez[2]

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Inwater Research Group (IRG) saw a growing need of non-educators, including scientists and volunteers, to bring sea turtle education to both students and the public. In 2017, IRG created a program for non-educators that do not have the experience or resources to build outreach tools. This program is tailored to multiple audiences with hands-on components that stimulate conversation and critical thinking among participants. Housed in wheeled traveling trunks, our Turtles to Go Program (TTG) can be presented to audiences of all ages and backgrounds. Each program elucidates threats facing sea turtles today as well as how participants can help improve their plight. Connecting a hands-on experience, through collecting data on model sea turtles, with newly attained sea turtle information, garners stronger emotional responses to the information and ensures long term knowledge retention. With the success of this program, Clearwater Marine Aquarium (CMA) and Inwater Research Group (IRG) partnered together to fill a pressing need on the west coast of Florida. The areas served (Hillsborough and Pinellas Counties) are home to growing Hispanic communities who don't have equitable access to many conservation-related resources. What's more, these communities struggle with connecting the importance of conservation to their everyday lives. The need to bring relatable, understandable, and impactful conservation to these areas is immense and oftentimes overlooked. Upon translating IRG's TTG program into Spanish, CMA staff utilized it to reach their local underserved Spanish-speaking communities. Within the first year, the program took off, becoming popular thanks to CMA's dedicated scientists and educators. Since its inception in 2018, CMA staff has offered over 30 group presentations (despite COVID) in both Pinellas and Hillsborough Counties. Participants spanned between 3 and 82 years old with Mexico as the most prevalent country of origin. Participants, often families, learned together what it means to be environmentally responsible and how to take action in their daily lives. With the success of this program, we have since branched out of our state and are now looking for international partners who find themselves in need. We are offering this powerful program to organizations outside the U.S. that lack the resources, but have the drive to educate their local Spanish-speaking communities. Our partners will receive a donated trunk program (in Spanish), tailored to represent the sea turtle species that exist in their region of the globe. Both IRG and CMA will assist partners to ensure program success over the years. The trunks will remain with our partner organizations in perpetuity and continue to educate those in need for years to come.

COMMUNITY-BASED TURTLE TOURISM INITIATIVE AT BLUFF BEACH, BOCAS DEL TORO, PANAMA

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Bluff Beach (9.419 º N, 82.256 º W) on the Caribbean coast of Bocas del Toro Province, Panama, was declared a Municipal Reserve in 1997. It is a 4.3-km beach that hosts approximately 100-200 leatherback (*Dermochelys coriacea*), 100-200 hawksbill (*Eretmochelys imbricata*), and 1-5 green turtle (*Chelonia mydas*) nests each year. Since 2010, there has been a regular monitoring and conservation program for sea turtles on this beach. The initiative is coordinated by a local community conservation organization, ANABOCA "Bocas Hawksbill Natural Association", with support from the Sea Turtle Conservancy. In the early years, 2012 to 2014, it had financial assistance from the USAID Regional Program for the Management of Aquatic Resources and Economic Alternatives. In 2014, the Community-Based Turtle Tourism Initiative was established to supervise a maximum of 16 people in two groups per night in order to further the development of tourism activities within the Bluff Beach Municipal Reserve. The Turtle Tourism Initiative provides high-quality turtle beach experience for visitors as well as an operational and administrative framework for the sustainable management of tourism in the Reserve. It was developed to reduce environmental impacts of unregulated visitation while increasing the economic benefits to the local community. During the 5 years of this initiative, a limit of eight people viewing each nesting turtle and a standardized time (9:00 pm to 12:00 am, April - August) for visits have been established. Local indigenous interpreters are trained annually to provide information to visitors. Between 100–300 visitors are received per season, which has allowed this initiative to function successfully. Although additional work with the local association is needed to improve organizational skills, the results have demonstrated that this initiative can be sustainable and helps to deter poachers. However, there is concern about the increasing pressure created by coastal development on Bluff Beach which negatively affects sea turtles and their nests. The continuity of this project and the strengthening of the community's involvement are extremely important for documenting the level of nesting on Bluff Beach and for the protection of sea turtles in the Reserve. Bluff Beach is easily accessible by road from Bocas town, a developing ecotourism center. We hope that promoting this site as a location for observation of sea turtles will reduce pressure to add infrastructure and allow nighttime visitation on other more remote nesting beaches, especially those within other nearby marine protected areas.

HOW WAS THE ENVIRONMENTAL EDUCATION AFFECTED DURING TWO YEARS WITHOUT CLASSES IN SCHOOLS IN PANAMA?

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Sea Turtle Conservancy, Panama

The pandemic severely affected the quality of Panamanian education, although the Government tried to minimize the damage caused by Covid-19 in the education system through virtual, modular, radio and/or television classes. Despite these efforts, two years in this mode have had a negative impact on the basic skills needed by students for academic and social development. This, in turn, is reflected in the fact that there are no spaces to talk, relate, learn, give feedback and share as in a classroom, topics such as environmental education were relegated or in some cases completely omitted. In indigenous communities near nesting beaches where there is no good internet, the impact was more dreadful. The STC with its Education and Outreach program endeavored to educate the public about sea turtles, and the environment, including communities as the first line of allies in the conservation of species. In 2020, it was not possible to approach these areas, the actions were concentrated on making the activities of the sea turtle monitoring and conservation program visible, therefore the efforts were focused on the use of technology in communication in social media networks, participation in online events and virtual platforms used by institutions and/or companies, making the message of conservation more noticeable to attract an audience immersed in online communication. In 2021, while some health measures were reduced by Covid-19 and with schools closed in person, some in-person activities were carried out with the communities. However, the social media network allowed a greater number of people to know and share more about the organization and the importance of the beaches of Bocas del Toro and the Comarca Ngabe-Bugle for the Leatherback and Hawksbill species throughout Panama and internationally. In some areas: student desertion, the lack of allies in schools or schools where only modular classes were implemented, environmental activities were compromised. However, by approaching groups interested in conservation present in the communities, and by carrying out activities that allowed the creation of relationships, it contributed to strengthening the skills and abilities of students and community members to raise awareness about their resources and the environment. In addition, worked on those gaps that the students had because they were not in classrooms. This has allowed the STC Education and Outreach Program to have best practices and optimize processes to develop activities that contributed to the process of learning in students and the general public.

SEA TURTLES, GAMES, SPORTS, ART AND RECYCLING AT SCHOOL NO. 29 OF LA CORONILLA, (ROCHA, URUGUAY), 2022

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Karumbé has carried out several projects related to the plastic waste pollution problem. Since 2004 Karumbé has been linked to School No. 29 of La Coronilla, located in the facilities where the organization's Scientific Base has been operating since 2005 in the department of Rocha, Uruguay. As During previous years, educational workshops and activities have been held (such as Sea Turtle Festivals) whereas the workshop's contents have been based on the coastal zone and its biodiversity. The initiative is carried out together with the Plasticoin project and La Coronilla Surf School and its main objective is to address through Environmental Education (EE) the issues that lead us to rethink our link and relationship with plastic such as reflecting on the waste load of plastics in the coastal zone, how it affects biodiversity and how we can relate waste to sport and art. In order for the meetings to be interdisciplinary and with a direct link with the local community, the alliance with the Plasticoin project and La Coronilla Surf School was created. These new allies have experience in this process of rethinking plastic and avoiding it through different alternatives. The interdisciplinary team that executes the project is made up of the education team of the NGO Karumbé and teachers of the Surf School. A plastic collection point was placed at the headquarters of the Surf School, inviting the girls and boys of the School to classify and classify plastic elements, which were then managed, recycled and transformed by Plasticoin into "virtual currencies" that the School and Karumbé would be able to exchange for discounts in shops and stores to acquire veterinary materials or supplies. To that initiative, we added several face-to-face meetings at the School and activities based on EE, using sea turtles as a flagship species and a link between the School, the coast, games, sports and art. Each meeting was planned and evaluated with the teachers of School No. 29, which allowed them to be didactic meetings with content that can be supported with work in the classroom. This approach was successful in initial and primary education levels, reaching a total of 184 girls and boys residing in coastal neighborhoods, in addition to 8 teachers and families who supported the classification of waste and participated in the activities on the beach together with said children. La Coronilla is the main feeding area for green turtles (*Chelonia mydas*) in the country. We understand it is necessary to foster alliances that favour the relationship with local communities and provide tools for the conservation of the coastal zone and its biodiversity. This relationship with educational centres allows us to continue working in the long term with the community. Working together with local references such as the teachers of the Surf School and the person in charge of the Plasticoin project allows us to have strategic allies when it comes to facilitating communication at a local level with the community of surfers and raising awareness about plastic waste.

*ENVIRONMENTAL EDUCATION IN PANDEMIC: VIRTUALITY AS A TOOL TO BRING THE OCEAN AND SEA TURTLES CLOSER TO EDUCATIONAL CENTRES AND HOMES

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During the course of the global health emergency due to the COVID 19 virus, the situation of confinement in homes allowed the Karumbé organization to bring sea turtles and ocean conservation closer to homes through different platforms and furthermore, to educational centres in various parts of Uruguay. Workshops within the framework of the "Aula Tortuguera" educational program, various activities and projects that had dates already scheduled and confirmed for March 2020 had to be re imagined in remote conference fashion to be carried out. This allowed the use of virtual conference as a fundamental tool when working with educational centres. As a background to virtual environment work, since 2018, Karumbé has carried out some specific workshops through the Skype platform with various educational centres in the country. Despite the lack of physical presence and the uncertainty about how the health situation in the country would evolve, many teachers requested to continue with their educational projects and give space in the virtual classroom and homes to environmental education through meetings with education team members the NGO Karumbé. Using various platforms and tools (including Zoom, Meet, CREA, Canva and Youtube among others), virtual dynamics were planned and audiovisual content and educational materials were created in order to carry out several virtual meetings with children, teenagers and teachers of 15 educational centres from various parts of the country. As the health emergency in the country unfolded, educational centres that sought to have different activities through the platforms in which they taught their classes adhered to our efforts. This way, in 2020, a total of 175 girls and boys were connected from their homes, along with their fathers, mothers, grandparents and siblings through educational centres that worked virtually. For the year 2021 this increase was greater, 45 virtual meetings were held, reaching a total of 15 educational centres that requested environmental education workshops, making up for a total of 688 children and teenagers, 23 teachers and 188 families. By the year 2022, the numbers increased again, reaching 43 educational centres, 1,462 children and teenagers, 47 teachers and 642 families and a total of 39 virtual meetings. Virtuality allows us to continue working long-term and annually with educational centres and communities from other departments of the country, which are more difficult to access in person due to lack of budget for travel expenses. However, not being able to be in physically present at educational centres has not been an impediment to bringing sea turtles, the conservation of the ocean and the biodiversity associated with the coastal zone closer to said centres, both close and not close to the Uruguayan coast. The change to virtuality was successful, due to the very good reception of the educational centres, since it also made it easier for them to integrate families in our educational workshops. We understand that it is necessary to continue using virtual tools in order to reach more educational centres in the country and the homes of both children and teenagers.

ENVIRONMENTAL EDUCATION STRATEGIES FOR THE CONSERVATION OF SEA TURTLES IN THE COLOMBIAN CARIBBEAN IMPLEMENTED BY THE PROCTMM

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Pedagogical tools allow the interaction based on the experience, these are ideal in certain processes of reflection, awareness making, changes in attitude and aptitude, and the research of alternatives for the solution of troubles around. In that way, the Sea Turtle and Marine Mammal Conservation Program (ProCTMM in Spanish), working with Petrobras, Mundo Marino Aquarium, Universidad de Bogotá Jorge Tadeo Lozano, and Sila Kangama Foundation, has designed and implemented talks, workshops, and training, with the use of interactive presentations, maps, informative and outreach material and ludic activities, aimed to the coastal communities of the Colombian Caribbean in favor of the conservation of sea turtles, addressing issues that range from their ecology and biology importance and their relationships with strategic marine-coastal ecosystems, generating individual and collective agreements for the protection of the four species that nest in the country: *Caretta caretta*, *Eretmochelys imbricata*, *Dermochelys coriacea* and *Chelonia mydas*. The work carried out with rural educational institutions and the creation of the Voluntaritos group stand out, where children and youth participate in spaces of rapprochement with the turtles in head starting program in the ProCTMM until their introduction to the natural environment, as well as the vinculation of fishing communities and their families in the departments of Magdalena (Taganga, Mendihuaca, and Don Diego) and La Guajira (Palomino and Dibulla) for the protection of this reptiles. This material has made it possible to consolidate basic methodologies to join efforts and promote the exchange of empirical and technical knowledge, based on the interaction between these species and the local inhabitants.

*GYPSY TURTLE: A MUSICAL, PLAYFUL AND TECHNOLOGICAL STRATEGY FOR THE PROTECTION OF SEA TURTLES FROM ENVIRONMENTAL EDUCATION

Diana del Pilar Ramírez

Fundación Tourtugas, Colombia

The development of new information technologies and data storage in the cloud has meant that CD's and DVD's, in which we could previously store everything from data to movies and music; it is currently considered a little less than obsolete. For this reason, they have become one of the residues that are frequently seen in the garbage, since not all people know or have the facility to recycle it correctly. CD'S and DVD'S are made of polycarbonate, a hard, high-strength plastic that degrades fairly slowly, but when it biodegrades in the sea, it can release bisphenol A, an endocrine-disrupting chemical that can have serious health consequences. Marine life; as discovered in the study conducted by Japanese scientists at Nihon University in Chiba in 2010. For this reason, with the support of the first post-consumer program for CDs and DVDs in Latin America called RetroCD, we developed Gypsy Turtle a Jukebox turtle, in which the CD or DVD is the currency that allows you to listen to music. while these wastes are collected for later recycling. Gypsy Turtle Jukebox, is an initiative that responds to our main work strategy for sea turtles in Colombia: environmental education. Through it, the passage of the theoretical discourse of environmental education is evidenced, to take it to the communities in a playful way, promoting the proper management of solid waste, especially plastic and its impact on sea turtles; which also responds to the global trend of the circular economy, as a factor of innovation for conservation. It is a portable device that allows it to be moved to different settings and around which the community in general receives a brief awareness talk, before inserting the CD to play the music. Its design and operation is based on recycled or free and low-cost materials. During the year 2022, approximately 7000 CD'S / DVD'S were collected, which are delivered to the fixed point that has the RetroCD program. We hope to be able to replicate the Gipsy turtle in sea turtle nesting grounds.

CONTRIBUTIONS OF ENVIRONMENTAL EDUCATION TO THE CONSERVATION CAPACITY INDEX INTEGRATING HUMAN DEVELOPMENT, THE ECONOMY AND THE STATUS OF SEA TURTLES, WITHIN THE FRAMEWORK OF THE SDGS

Diana del Pilar Ramírez

Fundación Tourtugas, Colombia

Within our work as environmental educators with sea turtles, we know the importance of developing pedagogical tools and experiences, in order to promote an informed citizenry for decision-making from the local to the global; tools to train leading citizens, aware of the importance of our interaction with nature and especially with our oceans. For this reason, based on some global approaches to the human-nature relationship, such as the Sustainable Development Goals (SDG), and the "Conservation and Compliance Capacity Index (CECI)" proposed by Héctor Barrios, Garrido, Takahiro Shimada, Amy Diericha and Mark Hamann we designed a pedagogical tool that allows us to try to elucidate, if there is a hierarchical order to address and achieve the proposed approaches in terms of conservation, and in particular the conservation of sea turtles; or on the contrary if they should be addressed in an integral way. The Sustainable Development Goals (SDGs) constitute a planning tool for governments, as well as being a vision of the future that all human beings want in a friendly way with our ecosystems, not only in terms of conservation; but in equality, inclusion and accessibility. The "Conservation and Compliance Capacity Index (CECI)" states the close human-nature relationship around the world, and how this relationship can be affected by the socioeconomic conditions of each country. According to this index, some countries with better socioeconomic conditions reflect a better state of their natural ecosystems and their wildlife, compared to those nations that have worse literacy, health and economic indices; compromising the capacity of governments for the environmental management of their territory and in particular sea turtles. One of the important variables in the construction of the "CECI" is the "Human Development Index" (IDH), which allows quantifying the level of health, education and quality of life in each of the countries; This index is also closely related to the achievement of the Sustainable Development Goals, since it qualitatively measures health, educational and economic factors. Our pedagogical tool hopes to put these global approaches into practice in environmental education citizen projects for the conservation of sea turtles.

WASTE MANAGEMENT PROGRAM: AN ALTERNATIVE TOOL FOR SEA TURTLE CONSERVATION

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Plastic pollution in the marine environment is recognized as a global problem for marine wildlife. One of the most affected species by this threat are sea turtles, which have been heavily exposed to plastics in the last decades in all their habitats. San Francisco de Coyote is a rural Costa Rican community located on the Southern Nicoya Peninsula. This small community is compound by around 240 inhabitants, and it is surrounded by four sea turtle nesting beaches. At present, San Francisco de Coyote lacks essential services such as waste collection, which results in the accumulation and burning of waste or litter that ends up in the nearby rivers and subsequently in the sea. In 2010 a local from this community started a solid waste management program in order to reduce and recycle the plastic produced in his community and its surroundings. Since 2017 the NGO Rescue Center for Endangered Marine Species and Turtle Trax S.A, an eco-tourism and volunteer agency focused mainly on sea turtles, started to collaborate with this program, promoting and supporting this initiative in the area. However, even though this grass-root program has been ongoing for more than a decade and counts with the support of two locally renowned organizations, there is still a lack of engagement from San Francisco de Coyote and neighboring communities. To get a better understanding of the issue and promote waste management, we have been conducting social research since September of 2022 consisting of 10 semi-structured interviews with locals of San Francisco de Coyote in order to understand their perception of the waste management program and its implications on sea turtle conservation. We focused the interviews on four main subjects: sea turtle knowledge and conservation, plastic pollution impact and solutions and the solid waste management program. So far, in this ongoing project we found that all the interviewees (n=10) acknowledge plastic pollution as a problem in the area. However, some respondents are not aware about the existence of the program (30%). They also maintained that there is a lack of information regarding the service (50%). On the other hand, all interviewees were aware of sea turtles nesting on nearby beaches and most of them were aware about the negative consequences of plastic pollution on these species (80%). Complete results will be finalized by January, by the end of the nesting season in the area. This preliminary assessment is an example of a different approach to sea turtle conservation. Using sea turtles as flagship and umbrella species could be an essential tool to increase awareness and involve communities in programs that benefit the whole marine ecosystem, like waste management programs, especially when there is a lack of resources and interest in marine wildlife.

MÉM DI OMALI: USING SOCIAL MARKETING TO REDUCE DEMAND FOR SEA TURTLE MEAT AND EGGS IN SÃO TOMÉ ISLAND, WEST AFRICA

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Despite several conservation efforts over the last decade, sea turtles are still heavily exploited for human consumption in São Tomé Island, West Africa. This has contributed to the eminent extinction of the critically endangered Eastern Atlantic Hawksbill Sea turtle, and is affecting the populations of three other threatened sea turtle species. Program Tatô, initiated in 1998, has been the key driver of sea turtle research and conservation in São Tomé. Ongoing activities include the seasonal involvement of members of local communities to monitor and protect the key nesting and foraging sites, as well as undertaking educational and awareness activities. In response to concerns raised by the national NGOs, the government implemented a national legislation in 2014, criminalizing the consumptive use of sea turtles and their by-products in the country. However, sea turtle products were still sold openly in city markets due to high meat demand until 2016. In order to reduce the consumption of sea turtle meat and eggs in the country Programa Tatô conducted a market research study to understand the social and cultural drivers of sea turtle consumption and the most trusted communication channels and influencers that could be used to effectively promote a behavior change in São Tomé Island. The insights gained were used to design and implement asocial marketing campaign called “Tataluga Mem Di Omali” (Sea Turtle the Mother of our seas, aiming to influence consumer behavior and reduce the demand for sea turtle meat and eggs, using a mix of community events, traditional mass media and social media focused on reframing sea turtles as part of the Santomean natural heritage. Here we present the main insights gained on the audience research and the main activities developed and implemented in São Tomé as part of the marketing campaign. This research showcases the importance of an audience research to implement a structured and effective approach to obtain an actual behavioral change.

*NATURE EDUCATION-BASED SEA TURTLE PROJECTS: INCLUDING NATURE IN OUR EDUCATIONAL PROGRAMS IN ORDER TO ENHANCE EMOTIONAL CONNECTIONS & ENVIRONMENTAL BEHAVIOURS

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Sea turtles represent one of the most charismatic species in the ocean, providing the motivation for countless environmental movements and campaigns as well as acting as emblems and community symbols. From a more educational perspective, sea turtles can help conservationists to reach and enhance people’s

environmental awareness. They have the power to change people's attitudes towards the environment (*Eckert, 2005*); thus, it is incredibly valuable to use them as stewards of marine ecosystems. The main focus of sea turtle research and conservation projects has been learning more about them, protecting endangered populations and avoiding large scale massacres through data collection and analysis. In the last two decades, sea turtle projects (STP) have started including environmental education programs (EEP) in their agendas, trying to achieve the perfect formula towards their conservation (*Brewer, 2002*). Many studies support the role of education as one of the most powerful tools for environmental conservation and sustainable development as well as the importance of distinctions in cost-effectiveness of different educational strategies (*Howe, 2009*). Yet, EEP in STP are usually perceived as intervention tools and frequently there is no defined strategies; likewise, the main approaches followed (talks, conferences and workshops) are still really traditional and unidirectional, with passive participation (*Rangel, 2014*) and focused on concept-learning. Supporting that, researchers have increasingly highlighted the need to include nature-based activities in educational programs, as this generates an emotional connection, which is a precursor to environmental awareness and responsibility (*Louv, 2009*). The traditional linear relationship between knowledge and behaviour change has therefore been extensively critiqued (*Kolmus, 2002*) with suggestions that say that a knowledge-based approach may not necessarily affect deeper held values of the kind that might drive an individual to alter their behaviour (*Gurevitz, 2000*). In the present case, a quantitative and qualitative online questionnaire that has been sent to different international STP, will be analyzed, interpreted and exposed. With topics such as: "How are you approaching environmental awareness in your STP? How often is nature included as a part of the EEP? Are EEP learning processes more focused on concepts, experiences or values? we will be able to capture important information about the current approach EEP have in STP, what's their understanding on that and how frequently is nature included as a part of the learning and awareness process. All this data, supported by current research on the benefits of nature education, will be presented in order to take a look at the present situation in STP, strongly advising them about the importance of including nature activities in their educational programs as a path towards the creation of environmental awareness and therefore, attitudes. With the help of STP, defined strategies and solutions will be given in different scenarios that can be replicated by many STP around the world.

FISHERIES AND THREATS

SEA TURTLE STRANDINGS ALONG THE NORTHWESTERN MOROCCAN COAST: SPATIO-TEMPORAL DISTRIBUTION AND MAIN THREATS

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We present the first research carried out on a large spatio-temporal scale (324 km) on sea turtle strandings during a 24-year period (1998-2022) in northwestern Morocco. A total of 208 stranded turtles were recorded. Among these were 184 (88.47%) loggerheads, *Caretta caretta*, 21 (10.09%) leatherbacks, *Dermochelys coriacea*, and 3 (1.44%) unidentified sea turtles. Strandings were most numerous in the Summer and early Spring, which coincides with the largest trawler, purse seine and longline fishing effort near the Moroccan coast. The majority of loggerhead turtles measured (81%) were subadult individuals, while the stranded leatherback turtles included subadults and adults. Our data demonstrate that Moroccan coastal waters are provide important development, foraging and/or migration habitats for loggerhead and leatherback turtles, and fisheries bycatch and boat strikes may be the major threats to sea turtles in Moroccan waters. This study serves as an important baseline for the development of sea turtle conservation efforts in the near-shore waters of the Moroccan Mediterranean coast.

*THE IMPACT OF CLIMATE CHANGE ON HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*): ASSESSING PRIMARY SEX RATIOS AND SEA LEVEL RISE IN THE UNITED ARAB EMIRATES

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Climate change poses existential threats to sea turtles. On the nesting beach, where sea levels are rising, stronger storms are causing erosion and destruction of their nesting habitat. Warming temperatures are likely to cause imbalanced sex ratios in offspring or complete failure of embryonic development. The Gulf region (Arabian/Persian) is already an extreme environment, with sea turtle incubation temperatures often above what is considered the thermal limit. Furthermore, nesting across much of the Gulf is on pocket beaches on low-lying islands. We set out to understand the likely climate change-related impacts to hawksbill sea turtles (*Eretmochelys imbricata*) nesting in Abu Dhabi, United Arab Emirates. Between 2019 and 2021, we recorded hawksbill turtle nest temperatures (n = 14) and sand temperature at nest depth over three seasons. We first investigated how incubation date and temperature affect incubation duration and hatching success. We further analyzed the temperature data to estimate the primary sex ratio. The results show a highly female-biased population of >80%, and only nests in the first three weeks of the season were likely to have produced male hatchlings. To further assess the impacts of climate change, we modeled three scenarios for sea level rise at two low-lying nesting beaches using drone-based photogrammetry. Nest

elevation and inundation impact estimation in each scenario indicated that although the islands will be profoundly affected, some nesting beaches within the core areas would remain as potential nesting sites. In the extreme scenario, without behavioral modification and beach remodeling, we estimate a loss of at least 72.8% and 55.0% of the nests at each site evaluated. We propose measures that could mitigate the impact of projected climate change and research priorities in this area in the Arabian region.

MARINE DEBRIS IMPACT AT SOUTHERN TURTLE NESTING AREAS OF MAHAHUAL

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Anthropogenic marine debris is one of the most challenging and growing concerns for marine and costal environments. Mahahual community has responded to this challenge with environmental stewardship of beach cleanups, brand audit, and circular economy of these litters. Through citizen science, we collected data from beach clean-ups between 2021-2022 in the southern nesting beaches of Mahahual (Puerto Angel and Punta Herradura) and correlated with beach patrol data. As a general trend, 7% of the nests contain marine litter. Of that group, 19 hatchlings were trapped inside. After the continuous beach clean-ups, the incubation and hatchlings success rates increased 19% and 17% respectively. We expect that our findings be used as baseline data in future national legislation and international policy.

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*INCORPORATING MULTIDIMENSIONAL BEHAVIOR INTO A DYNAMIC MANAGEMENT TOOL FOR A CRITICALLY ENDANGERED AND MIGRATORY SPECIES

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Conservation of migratory species exhibiting wide-ranging and multidimensional behaviors is challenged by existing management efforts that only utilize horizontal movements or produce static products in space and time. For the deep-diving and critically endangered Eastern Pacific (EP) leatherback turtle, tools that predict locations where turtles have high risks of being caught as bycatch are urgently needed to prevent further population decline. We incorporated horizontal-vertical movement model results with spatio-

temporal kernel density estimates and threat data (gear-specific fishing) to develop dynamic maps of spatial risk. Specifically, we applied multi-state Hidden Markov Models (HMMs) to a large biotelemetry dataset (N=28 EP leatherback tracks, 2004-2007). Tracks with associated dive information were used to characterize turtle behavior as belonging to one of three behavioral states (S1-transiting, S2-residential/mixed diving, and S3-residential/deep diving). Recent fishing effort data from Global Fishing Watch were integrated with predicted behaviors and monthly space use estimates to create maps of relative risk of turtle-fisheries interactions as functions of fishing gear type, behavioral state, and month. Drifting (pelagic) longline fishing gear had the highest average monthly fishing effort in the study region, and risk indices showed this gear to also have the greatest potential for high-risk interactions with turtles in residential and deep-diving behavioral states. Monthly relative risk surfaces for all gears and behaviors will be added to South Pacific Turtle Watch (SPTW) (https://www.upwell.org/sptw), a dynamic management (DM) tool for this leatherback population. These modifications will refine SPTW's capability to provide important predictions of potential high risk bycatch areas for turtles undertaking specific behaviors. Our results demonstrate how multidimensional movement data, spatio-temporal density estimates, and threat data can be used to create a DM conservation tool. These methods serve as a framework for incorporating behavior into similar tools for other aquatic, aerial, and terrestrial taxa with 3-dimensional movement behaviors.

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*BYCATCH OF MARINE TURTLES BY FRENCH LONGLINE FISHERIES IN THE SOUTHWEST INDIAN OCEAN

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Incidental catches by fishing activities are considered one of the most serious threats to marine turtles. Around Reunion Island, bycatch is mainly caused by longline fishing and five species are regularly captured: *Caretta caretta*, *Chelonia mydas*, *Lepidochelys olivacea*, *Dermochelys coriacea* and *Eretmochelys imbricata*. Since 2006, at the initiative of the fishermen, a partnership was created with the Kelonia care center to reduce the impact of bycatches on marine turtles. Thus, a series of training sessions were annually given and the opportunity to bring back turtles with ingested hook to the care center. This work proposes an assessment of bycatch in the southwest Indian Ocean from 2007 to 2021 and is relying on several features. It includes: (i) analysis of a first dataset provided by the Institute of Research for Development (IRD) on fishing effort and turtle bycatch (collected by fishers and by onboard scientific observers; NIRD=288); (ii) evaluation of survival rate of captured turtles taken care by Kelonia thanks to volunteer fishers (NKelonia=303); (iii) the promotion of networking and interviews with fishermen. Kelonia and IRD have recorded 303 and 288 turtles respectively caught in 2007-2021 in the study area with only around 20 similarities. As the observation effort covers 5 to 15% of the fishing effort, we estimate that 7400 turtles have been caught by French longliners over the timeframe. Catch rates per 1000 hooks have been estimated and range from 0.003 for hawkbills to 0.071 for loggerheads. Most of the turtles welcomed to care center were loggerheads (86%, N=303). Results showed no significant influence of hook type (circle and J type) on turtle survival. Furthermore, individuals who survived spent a significantly shorter stay on the vessel (2.9 ± 2.7days, N=168). Also, the mass and size of surviving loggerheads were significantly higher than those who died. And ultimately, survival rates for loggerheads (72%, N=248) were 3 times higher than greens (26%, N=13) and olive ridleys (22%, N=33). Therefore, since 2007, 66% of caught turtles (N=303) have been successfully rehabilitated. Since 2007, 43 captains willingly contributed to the partnership. Interviews with 18 of them revealed their willingness to continue their efforts, despite the lack of means and the absence of suitable tools to safely remove hooks. These results raise five essential points: (i) only 5% of the turtles taken by Kelonia are included in the IRD database; (ii) the number of catches is underestimated; (iii) these data concern only French longliners; (iv) the ongoing need to optimize data collection methods and protocols to refine these assessments; (v) the necessity of maintaining contact with fishermen and providing regular training. In the end, despite a negative impact of fishing activities identified on a global scale, Reunionese fishermen are already taking action to reduce their impact on marine turtles. In fact, the increase of knowledge on these species in the southwest Indian Ocean could not be done without their involvement. It is the responsibility of scientists to provide them with the keys and tools necessary to optimize turtle care on board.

*SURVEY OF MARINE TURTLE USE BY COMMUNITIES IN FIJI

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Irrespective of the laws in place – a prior moratorium, now illegal to possess, take, or sell marine turtles even for socio-cultural purposes – there is concern of a continued widespread harvest of primarily green and hawksbill marine turtles across Fijian indigenous rural and maritime communities, likely dampening turtle population recovery. To assess the drivers and motivations of marine turtle use and trade, harvest levels and fishing methods used by local fishers and community members, a team of enumerators from WWF-Pacific conducted interviews in 136 villages located in ten coastal provinces across Fiji using the WorldWide Fund for Nature (WWF) Turtle Use Project community-based sociocultural use and trade surveys. A total of 1186 responses were recorded during the survey period, in March 2021 and from early December 2021 until the end of March 2022. Of those surveyed, 27% confirmed catching one or more marine turtles in the preceding 12 months. Turtles were targeted year-round and on purpose and at night in comparison to being caught incidentally. Whilst farming and fisheries are the primary form of income and livelihood, marine turtles are targeted with the same intensity as fish, shellfish and crustaceans and used for consumption, ceremonial, or cultural purposes. The major turtle harvesting hotspots include the province of Lomaiviti, Macuata, Kadavu and Bua. It was estimated that at least 2420 marine turtles were harvested in the surveyed communities during 2021, made up of primarily green (~60%) and hawksbill (~40%) turtles. Compared to the last 5 years, catching of marine turtles was reportedly higher. Noting, there are hundreds of villages in Fiji, this estimated figure should raise significant concern that the small-scale fishery of marine turtles is likely far greater and likely having an impact on Fiji turtle populations. This may be particularly so for the Critically Endangered hawksbill turtle which has very small (estimated at 20-3) females nesting annually in Fiji. Fiji's long-standing conservation of marine turtles is likely at a pivotal turning point as it reviews the conservation, management and protection needs for marine turtles since the moratorium. A variety of survey output recommendations were made which include greater investment into effective community-centered management approaches that engage and mobilize traditional hereditary chiefs or leaders; establishing an approved mechanism, national quota or permitting system that would allow for limited annual marine turtle cultural use and/or complete protection of hawksbill and green marine turtles during the nesting season or nesting stocks or adult age-classes. Follow up surveys are to be undertaken during 2023 to extend data collection as consultation with communities and government stakeholders continue.

COLLABORATION WITH FISHERMEN - LESSONS FROM MOROCCO

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The Kingdom of Morocco extends from the Mediterranean into the Atlantic Ocean with a coastline of 3446 km. Loggerheads are the most commonly reported species in this region and juveniles and sub-adults loggerheads are the most common species and age classes encountered either stranded on the beach or in the fisheries. Sea turtles in Moroccan waters originate from several nesting populations such as North America, Cape Verde, and the Mediterranean indicating that the accidental capture of sea turtles in the waters of northwestern Africa is likely impacting various nesting populations in the wider Atlantic as well as the Mediterranean. Therefore, studies on bycatch began in Morocco in 2000. Training workshops have been carried out in several ports and landing stations, and fishermen have collaborated and provided important data. Prior to 2012, there were many turtle interactions with the driftnet. Currently, with the elimination of the driftnet, there are fewer interactions with the purse seine and trawls. Observers at-sea state that inshore fishing has an interaction of less than 5% with respect to the number of trips. Artisanal fishing does not exceed 1% of interactions in relation to the number of trips. In this study, we discuss factors that have reduced bycatch in Mediterranean Morocco, and additional measures that are necessary to minimize bycatch throughout the Atlantic and Mediterranean coastline of Morocco.

*GLOBAL PATTERNS OF ILLEGAL MARINE TURTLE EXPLOITATION

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Human exploitation of wildlife for food, medicine, curios, aphrodisiacs, and spiritual artifacts represents a mounting 21st-century conservation challenge. Here, we provide the first global assessment of illegal marine turtle exploitation across multiple spatial scales (i.e., Regional Management Units [RMUs] and countries) by collating data from peer-reviewed studies, grey literature, archived media reports, and online questionnaires of in-country experts spanning the past three decades. Based on available information, we estimate that over 1.1 million marine turtles were exploited between 1990 and 2020 against existing laws prohibiting their use in 65 countries or territories and in 44 of the world's 58 marine turtle RMUs, with over 44000 turtles exploited annually over the past decade. Exploitation across the 30-year period primarily consisted of green (56%) and hawksbill (39%) turtles when identified by species, with hawksbills (67%)

and greens (81%) comprising the majority of turtles exploited in the 1990s and 2000s, respectively, and both species accounting for similar levels of exploitation in the 2010s. Although there were no clear overarching trends in the magnitude or spatial patterns of exploitation across the three decades, there was a 28% decrease in reported exploitation from the 2000s to the 2010s. The 10 RMUs with the highest exploitation in the 2010s included seven green and three hawksbill turtle RMUs, with most reported exploitation occurring in RMUs that typically exhibit a low risk of population decline or loss of genetic diversity. Over the past decade, the number of RMUs with "moderate" or "high" exploitation impact scores decreased. Our assessment suggests that illegal exploitation appears to have declined over the past decade and, with some exceptions, is primarily occurring in large, stable, and genetically diverse marine turtle populations.

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*MARINE TURTLE TAKE IN THE GUAJIRA PENINSULA, VENEZUELA: A CURRENT ISSUE AND CONSERVATION ROOTS

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The Guajira Peninsula, located in the northwestern of the Gulf of Venezuela, is one of the most important foraging and developing areas for marine turtles in the Caribbean Basin. The Guajira Peninsula is an ancestral settlement of the Wayuú Indigenous People, which have traditionally taken and used marine turtles for generations as a subsistence and cultural resource. Nowadays, the Wayuú people are changing their traditional practices to the inclusion of commercial use of marine turtle products. Thus, the intentional capture of marine turtles still occurs. However, capture rates in the area since 2018 are unknown. Therefore, using an interdisciplinary approach, combining field data (between 2020 and 2022) and semi-structured interviews, we aim to update and quantify the take of marine turtles in the Venezuelan Guajira Peninsula. We collected the data through occasional (2020-2021) and standardized field surveys (2022) in the study area. We surveyed fifteen locations and recorded the date, location, marine turtle species (alive, or vestiges: shells, plastrons, skulls, etc.), measurement (Curved Carapace Length-CCL), and flipper tags. Additionally, to better understand the take of marine turtles and the drivers for the commercial use of this species, we conducted 15 semi-structured interviews. We found 159 records of turtle evidence (remains and living animals), the most affected species was green turtle (n= 145; 91.2%), followed by loggerhead turtle (n= 8; 5.0%), hawksbill turtle (n= 4; 2.5%), and leatherback turtle (n= 2; 1.3%). Most of the green turtles found were sub-adults (average 69cm ± 17.4 CCL, n= 99) (immature individuals). Most of the marine turtles were recorded during the standardized field surveys in 2022 (n=143, 89.9%). Finally, we retrieved four new turtle flipper tags from different Caribbean projects; one was tagged in Bermuda (1999), two in Bonaire (one tagged in 2015), and one was tagged by the GTTM-GV (in 2017). All the interviewees stated that the capture of marine turtles has always occurred in the Guajira Peninsula, however, they mentioned that this illegal activity has increased in the last years either for subsistence, or local trade between countries (Venezuela, Colombia, and Panama). Some respondents affirmed that during COVID-19 pandemic (2020 and early 2021), an important portion of the local families relied on consuming or commercializing marine turtle

products. The capture rate during COVID-19 lockdown apparently increased but only a few turtles were recorded during that year due to severe lockdown of the research staff. Positive conservation outcomes were observed after the field surveys and interviews performed in 2022, as 20 turtles were released alive, and four tags were recovered. Moreover, the Wayuú families and some communities have shown positive attitudes towards potential future programs that incorporate them as key stakeholders and as part of the solution to the marine turtle intentional take. Further monitoring and fieldwork are needed to better understand the implications of the increasing number of marine turtles taking in the Guajira Peninsula could imply in the region (e.g., Caribbean Basin). Multi-institutional and bi-national efforts are required for the management and conservation of marine turtles in the Gulf of Venezuela.

*CRAWL SCENE INVESTIGATION (CSI): MEASURING HATCHLING MORTALITY FROM ARTIFICIAL LIGHTING

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Track evidence of hatchling disorientation has shown that artificial lighting is one of the greatest threats to sea turtles on land. However, the rate or mortality from this threat is challenging to measure. We focused intense data collection on individual "crawl scenes" to measure hatchling mortality and assign these rates to measures of accuracy and precision in hatchling orientation. Our goal was to provide insight into managing factors that affect nesting beach hatchling recruitment. We measured effects from artificial lighting on light fields, hatchling orientation, and mortality at representative locations within a densely nested, 41-km stretch of beach on the east coast of Florida in Central Brevard County. In our study region, artificial lighting was measured every 1km, before and during a mandatory lighting regulation period, which began on May 1 each year. Hatchling orientation was measured at selected sub regions from July 1 to October 1, during the nesting and hatching season for loggerhead turtles (*Caretta caretta*) and green turtles (*Chelonia mydas*). We measured 252 nests total for hatchling orientation accuracy and precision at all representative locations, 100 green turtle nests and 152 loggerhead turtle nests. 15 (4 green turtle nests and 11 loggerhead turtle nests) of the 252 total nests were assigned forensic search methods. Results from this work revealed that 1) incorrect hatchling orientation was tightly correlated with lighted urban development and beach light intensity, 2) rates of hatchling disorientation and mortality were likely to have been vastly under-reported in previous years, and 3) the forensic search methods showed a relationship between terrestrial hatchling survivorship and orientation accuracy and precision.

*FAST GROWING URBAN AREAS AS POTENTIAL DRIVERS OF SEA TURTLE NEST PREDATION

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East Pacific (EP) leatherback turtles (*Dermochelys coriacea*) are one of the most endangered sea turtle populations in the world. Playa Grande, Parque Nacional Marino Las Baulas, Costa Rica is among the main index beaches in the region and the number of turtles has precipitously declined there due to a combination of illegal egg harvest and interactions with fisheries. Olive ridley (*Lepidochelys olivacea*) and green

(*Chelonia mydas*) turtles also nest at Playa Grande and are exposed to the same threats on the beach. Along with the increase in coastal development over the last decade, the number of racoons has increased at Playa Grande, becoming an important threat to sea turtles. Nest predation by raccoons has grown exponentially in recent years affecting most in situ nest, especially olive ridley and green turtle nests. We used camera traps to monitor raccoon activity patterns in relation to trash accumulation around the Park and tested the use of protective measures to deter raccoon predation. Seven potential nest predator species were found interacting with the trash, including coyote (*Canis latrans*), armadillo (*Dasypus novemcinctus*), opossum (*Didelphis viginiana*), hooded skunk (*Mephitis macroura*), spotted skunk (*Spilogale putorius*), gray fox (*Urocyon cinereoargenteus)* and racoon (*Procyon lotor*). Racoons were the most registered species. We found that there is a preference for the southern extreme of Playa Grande Beach and bigger racoon groups are found in this area ($X2 = 6.15$, d.f. = 2, $P < 0.05$). Higher availability of garbage modulates the presence of racoons in the south extreme of Playa Grande, making it the main point access to the beach. The kind of trash containers in the area highly influence racoons' activity and their garbage extraction success ($X2= 37.87$, d.f.=5, $P<0.001$), turning them into the biggest racoon attractor to the beach. During the las years, racoon predation on in situ sea turtle nest could exceed 90%. Nest protection methods like the hatcheries have been effective to regulate this predation by constant monitoring. In situ mesh surrounding the egg chamber seems to be working, avoiding racoons to dig. Racoons were more attracted to the nest during the first days and final week of the incubation period, and the mesh played an important role to increase hatch and emergence success.

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*INTERACTIONS OF MARINE TURTLES WITH NEARSHORE RECREATIONAL FISHING GEAR ON THE ISLAND OF MAUI, HAWAI‘I

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The entanglement of sea turtles in fishing gear is a global problem that impacts all species within the taxon. In Hawai‘i, nearshore recreational hook-and-line fisheries are the primary threat observed in stranded threatened green sea turtles (*Chelonia mydas*) and endangered hawksbill sea turtles (*Eretmochelys imbricata*). Under a collaborative agreement with NOAA Fisheries, Maui Ocean Center Marine Institute (MOCMI) manages a comprehensive sea turtle stranding response program and rehabilitation hospital. MOCMI maintains a stranding hotline, and responds to reports of injured, distressed, and deceased sea turtles on the island of Maui. For the purposes of this study, we define a stranding as any marine turtle found on land or in the water that is deceased, injured, or exhibits any indication of ill health or abnormal behavior. Between January 2019 and November 2022, the team of staff members, interns and volunteers at MOCMI documented 776 stranded sea turtles. Interactions with nearshore fishing gear accounted for 633 of the 776 recorded strandings. Of the 633 stranded turtles, 610 (96.4%) were live turtle responses. Species included green turtles (629 individual animals), hawksbill turtles (3 individual animals), and a single olive ridley turtle (*Lepidochelys olivacea*). The majority of the reports that come into MOCMI are from snorkelers, divers, or tour operators who observed a hooked or entangled turtle while recreating on Maui's nearshore reefs. Thus, 82.6% (n=523) of fishery-related injuries are "in water" responses. MOCMI's staff biologists assess the animal's condition, collect morphometric data, document all injuries, and determine if more extensive examination or rehabilitation measures are required at the facility. All associated fishing gear is collected, measured, and photographed. We catalogued nearshore fishing gear interactions into five distinct

categories based on the primary cause of stranding: entanglement (line), n=337; entanglement (net), n=17; foul-hooked, n=227; hooked (mouth), n=37; and hook/line ingestion, n=15. The most common injury observed due to interactions with near shore fishing gear results from front flipper entanglement. In collaboration with NOAA Fisheries, MOCMI developed a five-part severity classification system for entanglement injuries. These classifications assist with patient assessment, veterinary communications, and determine course of therapy. This system can also aid in the determination of the type of gear posing the most significant threat to the nearshore turtle populations. We will present the results from this process during the presentation. MOCMI staff also regularly conducts interviews with recreational anglers and local fishing stores to better understand fishing practices and sea turtle interactions. As the sea turtle populations in Hawai‘i improves, there continues to be an increase in nearshore fishery interactions. Scientists and conservationists must work collaboratively with the recreational fishing community to reduce entanglement threats.

SEA TURTLE STRANDINGS AND MORTALITY CAUSE IN QUINTANA ROO STATE, MEXICO

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Biodiverse areas, such as Quintana Roo State, require effective multidisciplinary recovery programs that allow long-term management in conservation. A keystone to achieving this is acknowledging research prioritization. Comprehension of stranding and mortality causes is critical for the identification of threats, resource management, and the sustainability of endangered species. Data on stranded sea turtles was examined between 2017 and 2020 along the coast of Quintana Roo State, Mexico. Complete necropsies were performed on dead sea turtles, and live-stranded animals were transferred to the nearest aquarium for rehabilitation. The principal stranding and mortality causes were obstruction (14%), offshore debilitation (13%), poaching (5%), boat strike (4%), entanglement (2%), and bycatch (1%). The remaining percentage corresponds to undetermined cases where the carcasses were very decomposed, and it was impossible to determine the cause of death, or no qualified personnel were in the area to perform a necropsy. The spatial distribution pattern trends showed higher incidence with fisheries, vessel strikes, and chronic debilitation at the north region. Urban development remains a main conflict in the center region, of which constructions endanger sea turtle survival in the long term. During the pandemic, more poaching cases were recorded in all the State; nevertheless, poaching and jaguar predation stood out in the south region. Our analyses

indicate potentially vulnerable sea turtle population groups in time and space. Future studies, including genetic analyses, will be important in estimating the impact of population mortality in this region. This data analysis provides key information for marine wildlife management plans in the Mexican Caribbean Region. We demonstrate the value of long-term sea turtle surveillance programs through stranding records and necropsy techniques in the field.

THE THREATS AND EFFECTS OF MARINE DEBRIS INGESTION BY GREEN SEA TURTLES (*CHELONIA MYDAS*)

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Marine debris is mainly made up of plastic derived from human activities, such as industrial, fishing or consumption practices. In addition, more than 6,000 tons of fishing nets are estimated coming in Brazil per year. Plastic ingestion by sea turtles occurs worldwide and more than 69,000 marine animals are impacted by fishing gear daily. Understanding the factors behind the main interactions between marine vertebrates and pollution is considered urgent and a research priority. The objective of this study is to identify the presence of marine debris in the gastrointestinal content and the correlation with the cause of death of juvenile *Chelonia mydas* rescued from the beaches of Bertioga to São Vicente (north: -23.7564027; -45.8398614 to south: -23.998762; -46.3919095), through the Santos Basin Beach Monitoring Project, a condition for the federal environmental licensing of Petrobras' activities in the production and flow of oil and natural gas, carried out by IBAMA. During the necroscopic examination of the carcasses, the diet content was washed in a 01 mm mesh sieve and subsequently analyzed qualitatively and quantitatively. A final diagnosis of the cause of death was also elaborete. The test used was the SPSS Statistical Software. Of the 156 individuals analyzed, 71.15% (111/156) had debris, totaling 1,424 fragments and 13 colors, classified as rubber (0.2%,n=3), straw (0.7%,n=1) , sponge (1%,n=15), foam (0.7%,n=1), latex (1.6%,n=23), monofilament fishing line (2.8%,n=41) and multifilament (1.6%,n=24), flexible plastic (64%,n=914), hard plastic (21.4%,306), semi-hard plastic (1.7%,n=25), pellet (3.6%,n=52), tissue (0.7%,n=11), aluminum and bioriented polypropylene (0.5%,n=8). The highest frequency of waste observed was flexible plastic and the most prevalent color was transparent, followed by white, blue and black. Only 35.25% (55/156) underwent histopathological examination due to the condition of the carcass, resulting in nutritional deficiency, parasitism, metabolic, anthropogenic and asphyxia/drown as causes of death, showing a significant association with the ingestion of monofilament fishing line ($\chi 2$ = 13.2; P= 0.029) and multifilament ($\chi 2$= 14.6; P= 0.019) and rigid plastic ($\chi 2$= 14.7; P= 0.014), mainly in cases with asphyxia, which represent 45.45% (25/55) of the total. The ingestion of non-nutritional items can cause intestinal compaction, digestive deficiency and a false sense of satiety, besides to causing body weight loss and resulting in serious health problems for the animal, such as anemia, reduced immune function, comorbidities and positive fluctuation, making them more vulnerable in the ocean to being strike over by boats and being entangled in fishing nets. The suffering and pain arising from this harmful interaction results in sufficient arguments to prove that marine litter represents not only a serious environmental, conservation, human health and economic issue, but is also an important welfare issue, which requires urgent action. Understanding the factors that affect the ingestion of debris by *C. mydas*, including types of debris ingested and its global distribution, relating to the life history and diet ecology of the species, can help in the identification of management priorities in the reduction of pollution in the environment and in decreasing the potential for debris ingestion by marine animals.

*CANARY ISLANDS AS LOGGERHEAD ENTANGLEMENT HOTSPOT: APPLYING STANDARD PROTOCOLS ON HISTORICAL DATABASES

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Marine debris is a global concern affecting hundreds of marine species due to their ingestion, entanglement or toxicity. Consequently, research in this field has grown in the last years and efforts for the standardization of methodologies to monitor marine debris impacts on marine fauna are essential. Special attention is needed for endangered species, mainly when this impact could compromise their lives, as is the case of sea turtles and entanglement. The INDICIT I and II projects have developed and implemented standard protocols to assess the impact of entanglement on sea turtles and biota for contributing to the evaluation of the Good Environmental State of European waters. Thanks to these projects, the Canary Islands were identified as a hotspot of entanglement of loggerhead sea turtles among the areas monitored by the partners of the project (8 countries) in both Atlantic and Mediterranean basins. This study shows the homogenization process and the analysis of the information available of sea turtle entanglement in the Canary Islands, from archives and databases of historic strandings records in this region. To achieve this goal, the collaboration of the stranding networks and the wildlife recovery centers of each island of the archipelago was crucial, who shared their stranding databases and records from historic archives. All the data obtained were homogenized based on the INDICIT protocol, together with complementary information collected from other sources (such as social media images), to finally extract detailed information about the impact of entanglement. More than 4000 strandings cases of sea turtles in the archipelago from 1987 to 2018 were obtained and homogenized. The application of the INDICIT protocol allowed to distinguish between stranding cases caused by incidental capture during active fishing activities (bycatch) and passive entanglement in marine debris, in 80% of the stranding causes related to fishing activities. The exhaustive analysis of these data revealed that entanglement has been identified as the main threat to loggerhead turtles in the Canary Islands, causing the stranding for 51.6% of the cases (considering that the cause could not be identified for 15.9% of the cases). In addition, heavy-duty sacks (land-based origin) was the most abundant entanglement material, followed by fishing nets, fishing lines and ropes (fisheries and maritime origin). The outcomes of this research show the efficiency of applying standardized protocols built by experts together with stranding networks managers, which allow to assess and compare the spatiotemporal trends of this threat among regions. This study confirms the Canary Islands as a hotspot of entanglement for loggerhead sea turtles, supporting the potential of this species as indicator of the health state of the marine environment.

*IMPACT SEVERITY ASSESSMENT OF PLASTIC INGESTION ON MARINE TURTLES ACCORDING TO QUANTITIES AND CHARACTERISTICS OF INGESTED PLASTICS

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Plastic ingestion is recognized as an emerging threat and a priority conservation concern for marine turtles. Their impacts on turtles' health are diverse, ranging from negligible to deleterious and lethal injuries, alongside the sub-lethal effects related to bioaccumulation of toxic plasticizers. A better understanding of these impacts is central to assessing marine turtles' vulnerability to the plastic pollution threat. In this study, we analyse the impact severity caused by plastic ingestion on green turtles, *Chelonia mydas*, according to quantities and characteristics of the ingested plastics. Examined turtles (N=150) were all juveniles (curved carapace length, CCL, mean 39.7 ± 6.1 cm; range 30.8 to 70.7 cm) collected in Uruguayan waters between 2014 – 2020. In order to assess the dose-response relationship between ingested plastic and impact severity, we (i) analysed the digestive contents of deceased stranded (n=45) and bycaught turtles (n=9); and (ii) examined the fecal matter of rescued (n=59) and wild-capture turtles (n=37). Plastic ingestion was detected in 70.7% of the studied turtles. We observed a positive relationship between the quantity of plastic ingested and impact severity assessed; turtles highly affected by plastic ingestion consumed larger volumes of plastic. Laminar soft plastics were the most consumed plastic type (38.2% of the total volume retrieved). Furthermore, their accumulation was significantly different according to the impact severity assessed in turtles. This suggests such plastics may be influencing the impact of plastic ingestion to a greater extent than other plastic types. The hazard of laminar soft plastics lies in turtles are able to ingest large pieces with no restriction of their mouth-gape due to pliability characteristics. Once these large malleable soft plastics reach the intestines, they are likely to act as mesh tangling up other plastic items, facilitating the compaction of fecalomas and eventually obstructing the digestive tract, as observed in turtles in which plastic ingestion was determined as the cause of death (n=10). Bayesian models on the effect of cumulative volumes of ingested plastic predicted that 2,630 mm3 of macro-items (plastics with volume over 1,000 mm3); 4,015 mm3 of meso-items (plastics with volume between 1,000 to 100 mm3); and 1,221 mm3 of micro-items (plastics with volume below 100 mm3) pose a 50% probability to cause adverse effects on turtle health. In addition, models indicated the probability of plastic ingestion to cause severe impacts is higher in turtles with CCL < 40 cm. This might be related to the opportunistic feeding behaviour of early juveniles in Uruguayan waters, which makes them potentially more exposed to the ingestion of plastics because of lower discrimination in selection of dietary items. The assessment proposed here represents an advanced and reliable methodology to analyze plastic ingestion impacts on marine turtles, and it would contribute as a valuable and replicable approach to similar assessments on other taxa.

S.O.S CARETTA - FISHERMEN FOR BIODIVERSITY

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Bycatch is considered one of the main threats to marine turtles worldwide and a primary driver of declining populations. Therefore, it becomes necessary to undertake mitigation actions for the preservation of these species. The effective implementation of bycatch reduction measurements can substantially minimize incidental captures. Moreover, it has been demonstrated that assistance by fishers to those remaining bycaught turtles could increase their survival until admission to rescue centres. S.O.S Caretta is an initiative that aims to involve actively fishing guilds in the conservation of marine turtles in Andalusian waters. This project acts at large-scale on four of the main fishing ports along southern Spain, working mainly with the trawler and purse-seine fleet (300 boats approx.). The project is coordinated by Asociación HyT in collaboration with the Cepsa Foundation, which has support from the regional government (Junta de Andalucía) among other public administrations and conservation organizations. Our mission is to provide technical support and training to fishers for the rescue and recovery of bycaught turtles. In less than a year after a series of inductions and workshops, the participant fishers have gotten to rescue successfully 36 loggerhead turtles, *Caretta caretta*. All the animals were transferred to the Center for the Management of Marine Environment Resources of Andalusia (CEGMA) for vet checking and rehab treatment when necessary. Turtles were released back into the Gulf of Cadiz and the Strait of Gibraltar after a favourable health assessment or successful recovery. Three of the recovered turtles were fitted with satellite trackers devices, which will provide novel and relevant information about habitat use in the south of Spain and migratory patterns to/from Andalusian waters. In addition, all these actions are supported by a strong awareness campaign about the preservation of marine turtles, which has reached 2000+ people so far. This campaign consists of open dialogues with the guilds, an itinerary exhibition, educational programs in local schools, and outreach activities during the public releases of the recovered turtles. Nowadays, marine turtle conservation lies within the cooperation and collaboration of different governmental institutions, organizations, and social sectors. In this respect, S.O.S Caretta represents a sizable step forward in the involvement of Andalucian fishers in marine turtle conservation. For success in this endeavor, S.O.S Caretta has been recognized with an award from the Spanish Coast Guard for its contribution to the United Nations Sustainable Development Goal to (UN SDG 14) "conserve and sustainably use the oceans, seas and marine resources for sustainable development".

HOW STRAY DOGS ARE THREATENING NESTING HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*) IN TREASURE BEACH, JAMAICA

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Treasure Beach Turtle Group, St. Elizabeth, Jamaica

The Treasure Beach Turtle Group is a growing non-profit organization that was established in 2012 in the rural tourism community of Treasure Beach, Jamaica to protect nesting hawksbill turtles in the midst of developing tourism. With only a few volunteers at first, and the guidance of the founder, a villa owner, sea turtle conservation has now become a huge part of the community, having both the young and the old interested in protecting this critically endangered species. Because of this, Instagram and call alerts from community members have supported our very small team to increase survey data collection during the nesting season, nest releases and when injured turtles are found along the very dynamic 7-mile coastal

terrain. In the 2022 nesting season, we have had a growing concern for the increase in stray dogs along the beaches, which resulted in two separate incidences of the grotesque mauling of two nesting female hawksbill turtles. A similar incident occurred in 2018, and combined, resulted in the potential loss of approximately two thousand five hundred (2500) hatchlings returning to sea. In one rescue effort, we traveled 206 km and nearly four hours for marine veterinary assistance in an attempt to save the wounded turtle. However, that turtle succumbed to injuries, we were able to perform a necropsy, and save 47 eggs which were later buried along the same beach where the turtle was attacked. In recognizing that there is a need for the basic veterinary trauma response for community-based organizations, we are partnering with a team of marine veterinarians to train our volunteers in best practices for injured turtles. With combined efforts from our team, The National Environment and Planning Agency (NEPA) and The Discovery Bay Marine Lab of the University of the West Indies, we continue to work together to preserve the hawksbill population.

EFFECT OF NATURAL AND ARTIFICIAL LIGHT ON GREEN SEA TURTLE (*CHELONIA MYDAS*) HATCHLINGS ORIENTATION AT TORTUGUERO, COSTA RICA

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The influence of artificial light on wildlife habitat has represented a major anthropogenic threat with negative repercussions to wildlife, especially in marine-coastal ecosystems. Sea turtles can perceive light spectrum waves between 340-700 nm. Several studies have demonstrated that light pollution (artificial light) influences the orientation and behavior of sea turtles during their nesting process and in hatchlings searching for the sea after hatching. Tortuguero, Costa Rica, is the most important nesting rookery for the green turtle (*Chelonia mydas*) in the Atlantic Basin, and it is also a location that receives a high number of tourists every year. The high number of tourists over the years has led to the creation of more local businesses (restaurants, hotels, etc.), thus increasing the use of lights in the village that disturb nesting and hatchling sea turtles. After more than 10 years of conservation effort between several government and private entities in 2021, public lights were replaced along the beach of the village of Tortuguero with a wavelength of 450 - 650 nm to minimize the impact of artificial lights on sea turtles. This study aimed to evaluate the effect of natural and artificial light on the behavior of *C. mydas* hatchlings along the 8 km study area daily monitored by the Sea Turtle Conservancy. During the 2022 nesting season we used the 'Fan Mapping' technique to point out the hot spot areas of the beach where hatchling misorientation occurs. Additionally, we conducted a light census on October using a Sky Quality Meter instrument to identify the areas of the beach with greater luminosity. Finally, we compared the effect of the areas with highest light influence to determine if the light (natural and artificial) has an effect on the orientation of *C. mydas* hatchlings when emerging from the nest. We recorded the data from 409 nests' emergences of green sea turtles throughout the study area along with a total of 519 lights measurements at 152 points throughout the study area. The lowest average brightness was 0.017012 cd/m2, the highest was 0.001041 cd/m2, and a total average of 0.001670 cd/m2 for the entire study area. Our data show that the light is affecting significantly the hatchling orientation in areas closer to the town, where the brightness is higher due to businesses and residences. This is the first study conducted since the turtle friendly lights were installed in Tortuguero. We hope that in the future, improvements in planification for the correct management of artificial light in the area will be considered, such as replacement of residencial and business lights, complemented by a strong education program, with the objective of minimizing the impact of artificial lights on the sea turtles that nest on Tortuguero beach.

BYCATCH REDUCTION TECHNOLOGIES FROM CONCEPTION TO (UN)SUCCESSFUL IMPLEMENTATION: THE BARRIERS AND THE OPPORTUNITIES

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Over 120 million people rely on coastal capture fisheries for their livelihoods, food security, and cultural identity. Fisheries also play a large role in many national economies of coastal nations. However, the incidental capture (i.e. bycatch) of nontarget marine species continues to pose global challenges for species conservation, ecosystem functioning, and fisheries management. This challenge is not new; researchers and conservation practitioners have been studying and implementing various approaches to bycatch reduction with varying degrees of success. However, much of this research has failed to consider the broader context in which these measures are being tested and introduced, resulting in relatively low acceptance and uptake by fishers. Specifically, bycatch reduction technologies (BRTs) have been widely tested but relatively few have been adopted and implemented, particularly in small-scale fisheries. Testing is largely concentrated under academic researchers while conservation action is under NGOs and government bodies, meanwhile fishers are both positively and negatively affected at each of these steps. This raises the question of where the barriers and the opportunities exist for each step within the multi-stakeholder process from conception to implementation. No systematic evaluation or framework of this process has been proposed. Therefore, through an extensive literature review of peer-reviewed articles and gray literature, I will develop a BRT process theory of change (TOC) that identifies barriers and opportunities, distinguished by industrial versus small-scale fisheries, to the extent possible. Subsequently, I will conduct global key informant interviews with relevant researchers, NGO stakeholders, and government counterparts to validate and refine the TOC. Due to my existing relationships in Trinidad and Baja, Mexico, I will engage with fishers to test assumptions in the TOC related to their roles throughout the process. Based on expert elicitation from the aforementioned interviews, I will offer recommendations on how to overcome these areas or how to capitalize on opportunities to improve each phase of BRTs in current and future plans. Bycatch continues to be a global issue that requires coordinated efforts across stakeholder groups and varying goals. Ultimately, bycatch reduction targets cannot be achieved without implications for stakeholders directly involved in coastal fisheries or those working on the periphery. This framework will offer insight on where we can improve the connective tissue throughout the process to support lasting success of technically sound and socially acceptable bycatch reduction solutions.

*A COMMUNITY SURVEY FROM SUMATRA, INDONESIA: WHAT ARE THE PURPOSES OF SEA TURTLE USE AND WHICH FACTORS INFLUENCE IT?

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The persisting exploitation of sea turtles for use (consumption, trade) is one of the main reasons why many sea turtle populations are on the edge of extinction, and their populations continue to decline in the Southeast Asian region. The use of sea turtles has been a common practice among communities for centuries. Sumatra (Indonesia) is considered one of the world's hotspots of sea turtle use, and the use of sea turtles in this area is historically high. Our study aimed to document and characterize the types, purposes (subsistence, cultural, medicinal, religious) and other specifics of sea turtle use in Sumatra to support the conservation management of sea turtles and identify the needs for further research. The information was collected by means of a semi-structured questionnaire. The questionnaire was based on a community-based turtle use and trade survey developed by the World Wide Fund for Nature (WWF) under the Turtle Use Project. The fieldwork was conducted between September 2021 and April 2022. We interviewed 140 respondents from three communities in North and West Sumatra. Our results indicate a high incidence of sea turtle use in all research sites (71% of the respondents). The most used turtle products were eggs (88%) and meat (45%). On the other hand, the most traded product was tortoiseshell (62%). Sea turtles were used for different purposes across research sites. Socio-demographic factors were found to influence the purposes and some preferences in sea turtle use. Our findings provide a better understanding of sea turtle use in Sumatra and have the potential to serve in conservation management to build more effective strategies for sea turtle protection. Especially tailoring the strategies that follow the specifics and needs of local communities and their integration into the dialogue center is crucial to the future conservation agenda.

SPACE-TIME ANALYSIS OF THE EVENTS OF STRANDED SEA TURTLES AND POSSIBLE CAUSES AT THE NACIONAL REEF PARK OF PUERTO MORELOS DURING THE 2017 TO 2022 PERIOD

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There are very few places in the Mexican Caribbean where constant and adequate record of sea turtle strandings is carried out, which is why important information for the knowledge of these causes is left out. Through the coordination between the community, tourism companies and the government, it was possible to shed light on 102 cases of stranding sea turtles of the species *Chelonia mydas* (45), *Caretta caretta* (29), *Eretmochelys imbricata* (25), *Dermochelys coriacea* (2) and *Lepidochelys kempii* (1) recorded from 2017 to 2022 in the Puerto Morelos National Reef Park (PNAPM) and its area of influence. It was possible to identify three areas (South, Center and North) with a high concentration of strandings, through the georeferencing and mapping of the reported events. The years with the highest number of records were 2022 (24) and 2018 (21). The months with the highest incidence of stranding events were August with 13% of the records followed by September with 12% and March, June and July with 11% respectively. 71 specimens were found dead, and necropsy was only possible in 34. Most of the 31 organisms found alive were transferred to Xcaret to receive specialized medical attention, and only a few could be immediately released. In 49% of the records, it was not possible to determine the cause of the stranding since it was not evident. In the cases that did show indications, it was possible to assign the cause of stranding to the following causes: weather (11%), fishing gear (9.8%), hits (5.9%), weakening (5.9%) and others (19%). Only in 1 of the records, plastic remains were found in the digestive tract. These results allow us to have a first record of sea turtle strandings and their causes, that will contribute to directing efforts for their attention and prevention in the PNAPM.

*IDENTIFYING TURTLE BYCATCH HOTSPOT AREAS IN SABAH, MALAYSIA

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Sabah is home to three turtle species, which are *Chelonia mydas*, *Eretmochelys imbricata* and *Lepidochelys olivacea*. These species are greatly threatened by fishing trawlers due to accidental captures. In Malaysia, fishers are not allowed to capture sea turtles as they are legally protected. However, this does not protect the sea turtles from being caught accidentally, and fishers discard the turtles leaving a gap in information on where and when these capture events occur. As part of an unrelated comprehensive project to assess shark and ray bycatch, electronic monitoring cameras were deployed on fishing trawlers to capture images of all species that were landed on a subset of 30 fishing vessel decks. Images of green turtle and olive ridley turtles were captured by the cameras. These images were stamped with date, time and GPS coordinates, and this provides us with accurate location data for each capture. Hotspot areas where most of the capture

events occurred were identified by combining and analysing all location data. Comparison between vessels will be carried as part of a wider analysis. These data will be used to investigate the spatial and temporal trends of these accidental captures, that can be used for future conservation management of the species and address the accidental catches of turtle, such as to protect the species in the hotspot areas from trawling or encourage the trawlers that operate in the hotspot areas to install Turtle Excluder Devices (TEDs).

LOGGERHEAD SEA TURTLE BYCATCH BY BOTTOM TRAWLING IN EAST SPAIN WATERS: EVALUATION OF THE PROBLEMATIC AND SOLUTIONS

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Loggerhead turtle by-catch by bottom trawling fishery has been previously documented as a threat to the species in the western Mediterranean waters. The stranding network of the Valencia region (East Spain) has received reports of loggerhead turtle by-catch by bottom trawling vessels over the last two decades thanks to several awareness campaigns. In the last five years, an average of 44 bycaught turtles per year were brought to ports of this region by bottom trawling fishers, showing a noticeable seasonality; since 60% of the events were recorded in winter months (December-March) as turtles may spend more time at the sea floor due to its brumation behavior over the continental shelf during that period of the year. Turtle Excluder Devices (TEDs) have been proposed as a successful solution to reduce turtle bycatch by bottom trawling fisheries in the Mediterranean, although very few tests have been carried out in Spain’s Mediterranean waters. In the context of the LIFE MEDTURTLES project, new tests are being carried out, not only to validate this conservation measure in the area but also to produce economic devices affordable by both, fishers and fisheries' administrations. Preliminary onboard tests using a plastic-made TED may allow to adjust the device to bottom trawling vessels operating in the region. Those tests revealed no economic loss for fishers. However, fishers informed that they would not capture valuable large fish species, such as monkfish or amberjack while using TEDs. According to turtle bycatch seasonality, a potential solution with the agreement of fishers could be the seasonal use of this device in winter months. New surveys and tests of new economic and flexible materials to produce TEDs are ongoing to ensure the efficiency of this excluder device and start to implement this conservation tool in the whole bottom trawling fleet of the Valencia region.

INTERACTIONS OF SEA TURTLES WITH SMALL-SCALE FISHERIES IN THE COASTAL WATERS OF MAHARASHTRA, INDIA

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Sea turtles are recognised in both the natural and sociocultural heritage of India. Five species – the green, hawksbill, leatherback, loggerhead, and olive ridley turtle – forage in its waters and all except the loggerhead turtle nest on the mainland and island beaches. Sea turtles in India are vulnerable to a number of threats, including fisheries. Maharashtra has a coastline of ~700 km from which ~4,000 gillnetters (the dominant fishery) operate. We have been conducting structured face-to-face interviews with small-scale fishers operating in the coastal waters of Maharashtra since 2018 (interrupted from 2020-2022 by the COVID pandemic). The survey tool is a modified version of that designed and validated by Pilcher et al

(2017) for the United Nations Environmental Programme Convention on Conservation of Migratory Species (UNEP CMS). Additional questions are among those from the Olive Ridley Project-Ghost Net Data protocol (www.oliveridleyproject.org). Surveys have been conducted in numerous districts throughout the state of Maharashtra, and we will report on common fishing gear and practices, and sea turtle- fishery interactions, including bycatch rates and entanglement in ghost gear, and outcomes. Sea turtles observed by fishers in this study potentially contribute to regional management units (Wallace et al. 2010) or distinct population segments (Seminoff et al. 2015), four of which are categorised as threatened by the IUCN and 6 of which are regarded as high-risk/high threat (Wallace et al. 2011). Knowledge of in-water populations on the west coast of India is scant, and fishers' ecological knowledge will contribute to our understanding of distribution and population trends and could identify areas for systematic investigation. Quantification of threats such as rates of bycatch and observations of sea turtles entangled in ghost gear can inform schemes to compensate fishers for the safe release of bycatch turtles, initiatives to safely dispose of unwanted and/or abandoned, lost or otherwise discarded fishing gear, and other management and conservation actions.

SEA TURTLE REACTION TO MOTORBOAT NOISE IN REUNION ISLAND, WESTERN INDIAN OCEAN

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The world's oceans are exposed to a growing series of anthropogenic pressures that threaten critical species, habitats, and ecological processes. One of them, still little studied in the case of sea turtles, concerns underwater noise, a chronic and increasing stress factor that affects a wide range of marine species. Understanding how sea turtles hear and respond to sound is the first step in assessing the impacts of ocean noise on these protected species. On Reunion Island, a small French territory in the south-western Indian Ocean, sea turtles cohabit with various nautical activities, and have to adapt to numerous coastal developments. The highest densities of turtles are concentrated on the west coast where the majority of nautical activities are found (scuba diving, sea tours, whale watching, jet skiing, etc.). And cases of collisions, often fatal, are increasingly numerous. We studied the reactivity of sea turtles to the noise of boat engines from four juvenile green turtles (mean size 62.3 ± 10.4cm) captured on a well-known dive site and equipped with Fastloc-GPS tags and animal-borne cameras (GoPro) with the initial objective of studying their feeding behaviour. They were released 5 minutes apart on the same day at the same location (where they were captured). The average duration of the video recordings was 02h56 ± 4min (min=02h51, max=03h00) and they were tracked on average 50.50±30.22 days. They all remain in the same area during the video monitoring (max distance 128m) and did not move far the days after (max distance 2.7km). On all video recordings, three turtles recorded boat engine noises to which they have systematically reacted. Either they were breathing and dived quickly and swam until they reached the bottom, or they were sleeping and started to move and activate themselves, or they were swimming, and in this case, they slowed down the time the noise passed, then started to swim again. The strongest reactions were observed when the engine noise was louder. And although the turtles were released at the same location and the time codes of the motor noise matched, the sound intensities differed. This suggests that they were not all in the same place and relatively far apart. Although these results are based on a small number of individuals, and they may have been disturbed by the GoPro equipment, these reactions suggest that sea turtles are sensitive to the noise of boat motors and could modify their behavior in areas where nautical activities are highly developed, as is the case on the west coast of Reunion. Insofar as the foraging green turtle population of Reunion Island is already subject to several stress factors related to anthropic activities on the island

(fishing, plastic pollution, habitat degradation, underwater observation, boat strike), noise pollution is an additional stress factor to be taken into account and further studied in our efforts to protect these animals.

THE CHEBBA (TUNISIA) LOGGERHEAD NESTING SITE THREATENED BY ARTIFICIAL LIGHT POLLUTION

Imed Jribi

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Like the majority of other living organisms, sea turtles need regular natural periods of both nocturnal and diurnal light. Unfortunately, the majority of sea turtle populations worldwide are under severe threat from the rising usage of artificial light. Therefore, efficient lighting control is essential in locations where commercial and tourist development are adjacent to nesting sites. After those on the Kuriat islands, the nesting beaches in Chebba rank as the second-most important nesting beaches in Tunisia. The beaches of "Essir" and "Sidi Messaoud" are heavily used and light polluted making it impossible to spot nests and when hatchlings emerge, lights lure them, and if no one comes to save them, they crash on the road next to the shore. Although they are thought to be minor, Chebba's nesting beaches need to be safeguarded. Recommendations are given which will enable protecting them because they can give an appreciable regional contribution, both in number of nests and in genetic diversity.

RISK OF VESSEL COLLISION WITH SEA TURTLES IN REUNION ISLAND: ASSESSMENT AND RECOMMENDATIONS FOR ITS MITIGATION

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Collisions between marine wildlife and vessels can have negative consequences for species and are a growing concern worldwide. Concerning sea turtles, the risk of collision is a significant cause of mortality. In Reunion Island, sea turtles and developing nautical activities share the same waters. The number of sea turtles injured by vessel strikes has increased by +300% since 2015, becoming their leading cause of mortality. In 2022, a state of knowledge was established, and hypotheses investigated to understand the factors responsible for the increase of collisions and to implement efficient emergency measures to reduce the impact. The analysis of existing data confirmed higher turtle densities in the west and south of Reunion Island. Juvenile turtles are abundant and use a reduced habitat located in 93% of cases within 300m of the reef, and at a depth up to 30 meters in 83% of cases. Mature turtles are less numerous and appear to be located more offshore. They represent a very small and threatened local relict breeding population that raises strong concerns for its preservation. The Kelonia Care Center has recorded 37 collisions since 2001, averaging 1 collision per year through 2014. Peaks from 4 to 6 collisions have been recorded in the last three years. 78% of the turtles died after a collision. The types of injuries recorded have evolved from marks on the shells characteristic of propeller impacts prior to 2015 to straight cuts on the dorsal and ventral sides characteristic of foils. Since 2015, the global number of recreational and professional vessels in Reunion Island has increased by 14% and 12% respectively. Meanwhile, the historical turtle population monitoring showed a significant increase until 2011 and then stability with annual variations. The increase in the number of boats and turtle numbers therefore do not appear to be responsible for this +300% increase in collisions since 2015. Lastly, surveys of vessel passage frequency and user practices were conducted from

4 coastal land-based observation points. For two sites with high collision rates, a potential correlation between the number of vessel passages and the number of collisions was found. A complementary investigation has evaluated the knowledge of 28 users on the speed regulations in force. Only 7% of the users were fully aware of the current regulations and 50% were partially aware. 93% were in favor of raising user awareness through information and communication. In conclusion, improving the respect of the regulations in force would contribute to reduce the threat but information and awareness need to be improved by clarifying and spreading key messages. A dedicated team raises awareness of speed limits at sea to reduce pressure and collaborates with the care center in case of collision. An online platform named OMEGA (omega.upility.fr) has been developed to promote responsible observation of sea turtles and cetaceans in Reunion Island for the general public. Speed controls at sea are a necessary complementary action for the protection of turtles.

NONLETHAL CAPTURE OF GREEN SEA TURTLES (*CHELONIA MYDAS*) IN FISHING WEIRS AS AN OPPORTUNITY FOR POPULATION STUDIES AND CONSERVATION

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Green sea turtles (*Chelonia mydas*) switch habitats during their development, moving from pelagic to neritic areas and then commuting between nesting and foraging grounds during adulthood. Due to their predominantly coastal habitats, they are under a range of anthropogenic threats. We monitored turtles incidentally captured in fishing weirs in Ceará state, northeastern Brazil, over a decade and provided an overview of capture rates in the fishery during previous decades. Between 2008 and 2018, 2335 captures were recorded, 76% were only once. Most recaptures (86%) occurred up to six months after the first capture, with a mean growth rate of 6.7 ± 3.6 cm year-1. Capture rates varied between years, with the highest rates during the historical period, peaking in 1962 (0.16 turtles day weir-1). Between 2008 and 2018, the daily capture rate was 0.07 turtles day weir-1. Similar to other areas, the use of turtles as a fishery resource seems to have reduced population sizes in the Atlantic Ocean. On the other hand, the intensive monitoring of local weirs provided an opportunity to mobilize the community regarding their conservation, which in turn could have supported the recovery of turtles from a number of distant colonies. The relatively constant and year-round capture of green sea turtles reflects the presence of individuals from different rookeries and demonstrates the importance of the region as a developmental ground for juveniles from different nesting areas, with high growth rates compared with other feeding areas. Partnership with local fishermen and the long-term monitoring of passive nonlethal fishing weirs are key tools in supporting sea turtle conservation.

*AN ENSEMBLE RANDOM FOREST FRAMEWORK FOR PROTECTED SPECIES BYCATCH ESTIMATION

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Monitoring protected species bycatch is required in the U.S. under the Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, and Marine Mammal Protection Act. This is typically achieved through placement of fisheries observers on vessels and a linear extrapolation of observed bycatch to the full fleet. However, these methods do not take advantage of considerable oceanographic data available and assumptions inherent to linear methods may not be appropriate for rare events like protected species interactions. Our goal was to use Ensemble Random Forests, a machine learning algorithm, to estimate protected species bycatch and compare these estimates to existing methods. We trained 25 independent ensemble random forest (ERF) models using bycatch and oceanographic data associated with 100% of Hawaii shallow-set longline (SSLL) sets (n=18,988) from 2005-2020. The SSLL fishery had 100% observer coverage throughout this period and therefore known amounts of interaction with our three protected species of interest: oceanic whitetip sharks (*Carcharhinus longimanus*, n=639 sets with interaction), loggerhead sea turtles (*Caretta caretta*, n=190), and leatherbacks (*Dermochelys coriacea*, n=102). We provided the algorithm with a suite of 26 oceanographic variables (e.g., SST, chlorophyll a, current velocity) gathered for the polygon defined by set and retrieval GPS coordinates, along with bycatch data for the three species, for all SSLL sets from 2005-2020. The algorithm used these data to assess and learn which variables were most associated with sets that had bycatch in the training data. We used the resulting models to predict protected species bycatch for 2021 SSLL sets at simulated coverage levels of 20-80% and adjusted these predictions by accounting for known rates of Type 1 and Type 2 error in out-of-bag predictions from the 2005-2020 data. Finally, we compared these ERF-derived estimates to those produced using a ratio-based Horvitz-Thompson estimator of bycatch at simulated coverage levels. Overall, the ERF algorithm was more effective at predicting sets with bycatch for oceanic whitetips than loggerheads and leatherbacks. This is likely a result of very low bycatch rates, and therefore less information regarding environmental covariates of bycatch, for the two turtle species. However, the oceanic whitetip estimates were very good; when asked to predict for all mean predictions of number of sets with bycatch for the 25 models was 27.9 sets (SD: 3.7) with bycatch, closely matching the actual 2021 value of 28 sets. The loggerhead (mean prediction = 8.18 sets, actual = 14) and leatherback (mean prediction = 4.59, actual = 3) estimates were biased low and high respectively. Mean ERF estimates for total bycatch were substantially more precise among model runs than those produced by Horvitz-Thompson estimators at the same coverage level (e.g., ERF SD of 2.5 at 20% coverage versus 29.9 for Horvitz-Thompson estimator). The accuracy of using ERF bycatch estimation depends largely on the efficacy of accounting for Type 1 and Type 2 error. The framework we developed shows promise for bycatch estimation and can be applied where abundant environmental data can be combined with observer records, provided that bycatch rates in training data are not too low.

*CAN LED LIGHTS REDUCE SEA TURTLE BYCATCH IN A COSTA RICAN SMALL-SCALE BOTTOM-SET GILLNET FISHERY?

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Bycatch in commercial gillnet fisheries is considered one of the main threats to marine wildlife and has caused the decline of several species worldwide. Light Emitting Diodes (LEDs) have been successfully tested as a sea turtle catch deterrent in Ecuadorean and Peruvian gillnet fisheries. Thus, we tested the use of LEDs in a Costa Rican small-scale gillnet fishery that operates nearby several olive ridley sea turtle nesting beaches, as a means to reduce sea turtle bycatch. This study was conducted in the artisanal fishing community of Bejuco on the Southern Nicoya Peninsula, Costa Rica, during the Eastern Pacific rainy season (May-November). We used four 100 m headrope length gillnets (4 sections), tied together to form a single 400 m long set, deployed on the bottom. We deployed 9 LED lights (every 10 m) on the headrope of sections 1 and 4, while sections 2 and 3 remained dark (control). The gillnet was set for 24 hours in front of four locations: San Miguel, Costa de Oro, Corozalito, and Bejuco, and were monitored once a day in the mornings. We recorded GPS position, date, species captured, Sea Surface Temperature (SSF) and depth (m). We recorded the total length of all specimens caught, as well as their final destination: discarded (dead/alive) or stored (for sale or domestic consumption). Sea turtles caught were identified according to their morphological characteristics, and their condition (dead/alive) and net in which they were caught (LED/no LED) was recorded. Due to logistic issues sea turtle measurements were not taken. So far, we have observed 54 gillnet sets and recorded a total of 2,859 specimens caught, among commercial and non-commercial species. The most common species include the Spotted Rose Snapper *(Lutjanus guttatus*) (n=1,446, 25.29%), the Pacific lookdown (*Selene brevoortii*) (n=770, 13.47%), and the Pacific Sierra (*Scomberomorus sierra)* (n=454, 7.94%). So far, we have caught ten olive ridley turtles (*Lepidochelys olivacea*) (4 alive and 6 dead), eight of which occurred in the sections with LED lights. Highest overall catch rate occurred in July 2022 (CPUE = 94.7). According to our findings, the use of LEDs in the small-scale bottom gillnet fishery of Bejuco, Costa Rica, has no affect upon the profitability of the fishing operation, not does it reduce sea turtle interactions. Catching turtle is a nuisance for these small-scale fisheries. Turtles are usually heavily entangled, and time is lost releasing them and repairing nets. This is the first study conducted in a bottom gillnet fishery using LEDs in the Eastern Pacific. Further studies will consider increasing the number of LED lights in the gillnets, variations in the distance between the lights, and measuring parameters such as turbidity. LED lights could be an affordable solution (400 UDS) to reduce sea turtle bycatch and help fishers improve their catch "operation".

*ARE OLIVE RIDLEY AND EAST PACIFIC GREEN TURTLES OUT OF DANGER? PRELIMINARY RESULTS FROM RAPID BYCATCH ASSESSMENTS FROM NORTHWESTERN MEXICO

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As a result of more than 40 years of joint conservation efforts between government, researchers, civil society and community members, green and olive ridley turtle populations are considered to be on the mend or recovered in the eastern Pacific Ocean, with both populations showing increasing trends at major nesting sites along the Mexican Pacific coast. Although both species are still listed as endangered and are protected in Mexico, questions are arising about their true conservation status, and most funding agencies are no longer including these species among their priority species. But are olive ridley and green turtles really out of danger? As part of a study focused on loggerhead and leatherback turtles bycatch along the Mexican Pacific coast, we conducted rapid bycatch assessments (RBA) to determine the level of marine turtle species bycatch. The method consisted of conducting surveys of artisanal fishermen, using and adapting a survey created by ProDelphinus and the Laúd OPO network to conduct a similar study. Between January 2022 and February 2023, we conducted 465 surveys in 44 communities across 8 states along the Mexican Pacific coast. Bycatch was reported in 330 surveys (71% of total), and olive ridley and green turtles were the most commonly caught species (66% and 45%, respectively). Bycatch patterns differed among states, driven mostly by differences in presence and abundance of each species across them. For example, whereas green turtle bycatch was reported mostly in the Baja Peninsula (where widespread feeding grounds are located) and close to its main nesting beaches in Michoacán, olive ridley bycatch was more frequently reported in proximity to its major nesting grounds, and in offshore areas, likely due to this species' foraging habits. Gillnets were the fishing gear most commonly associated with bycatch of turtles

(48%), and although 84% of the respondents mentioned that bycaught turtles were released alive, this is likely an overestimate as gillnets are typically soaked around the clock and are checked only daily or every 2-3 days (depending on the weather), leaving little chance for turtles to survive. When asked about how many turtles had been caught incidentally the previous year, fishermen reported bycatch rates going from 1 to 500 individuals per boat, with an average of 15 individuals caught per year (based on 261 responses). Considering only surveys where bycatch of olive ridley and/or green turtles was reported, we estimated that about 3212 green and olive ridley turtles were caught the previous year. On average, we only sampled 15-20% of the fishermen in the communities we visited, therefore it is likely that most values are underestimates of the real bycatch due to the potential disincentives related to reporting marine turtle bycatch. Talks with fishermen confirm that both olive ridley and green turtle populations are increasing in their feeding grounds. As these species occupy important fishing grounds for the artisanal fleet, it is necessary to keep monitoring these populations and continue working with fishermen to identify ecologically, economically, and socially practicable ways to reduce interactions between turtles and fishing gears.

ANALYZING THE ABUNDANCE OF FIBROPAPILLOMATOSIS IN GREEN SEA TURTLES (*CHELONIA MYDAS*) FROM CURAÇAO

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Fibropapillomatosis is a cancerous disease that impacts all seven species of sea turtles, and has been documented across all ocean basins. The disease is initiated by Chelonid Alphaherpesvirus 5 (ChHV5) and can be horizontally transmitted through the water column. It is important to document the prevalence of fibropapillomatosis as we continue to explore environmental predictors of the disease. Anecdotal observations suggest FP tumors are common in green turtles on some fringe reefs surrounding the island of Curaçao, but not observed on other reefs. We conducted 28 SCUBA surveys on reefs from May through August 2022 to document the presence or absence of turtles with visible tumors. We used photo ID techniques to ensure animals were not counted twice. We visited 12 dive sites and observed 45 turtles. Thirty-two (32) had external tumors and 13 did not. We observed green, hawksbill, and loggerhead sea turtles, but tumors were only observed on green turtles. Dive sites that had the highest prevalence of tumors were sites most adjacent to industrialization and urbanization. Five heavily impacted turtles were rescued and taken to a veterinarian to have the tumors removed. We hope to test water quality across the sites to determine if there is a pattern of tumors with distribution of poor water quality. We anticipate that this effort will give us more knowledge about comprehending fibropapillomatosis.

AT-SEA MORTALITY ESTIMATES OF LOGGERHEAD TURTLE IN SOUTHERN BRAZIL FROM STRANDING DATA

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Sea turtles are an endangered group and currently bycatch by fisheries is their major threat. The loggerhead turtle (*Caretta caretta*) interacts with different fishing gears and is often caught in pelagic longline, trawl, and gillnet fisheries. In the Southwestern Atlantic, trawling is the main responsible for the mortality of juvenile and adult neritic individuals of this species, while oceanic juveniles are often killed in pelagic longline fishery. The southern coast of Brazil is an important feeding area for the loggerhead turtle, with high records of strandings, mostly as a result of bycatch in industrial coastal fisheries. Despite the high number of stranded animals, little is known about the mortality at-sea. Data for other species have shown that only a small fraction of the total number of individuals that die at-sea ends up washed ashore. In this study, we carried out a mark-recapture study aiming to estimate the mortality of loggerhead turtles in southern Brazil, from stranding data. Between 2012-2016, 70 dead turtles incidentally caught in the pair trawl fishery were tagged and returned to the sea, with recording of date and geographic position. Beach monitoring was conducted biweekly, from Lagoa do Peixe to Barra do Chuí in an attempt to recover tagged turtles. Logistic regression models within a Bayesian approach were used to assess the probability of a loggerhead turtle incidentally caught to wash ashore as a function of the covariates distance from shore where the turtle was tagged, depth and season. Using the data of all loggerhead turtles stranded between 2012-2016 in the study area and the estimated stranding probabilities as a correction factor, we estimate the annual mortality of the species at-sea. In warm months (October to March), 48 turtles were marked and 12 were recaptured, in cold months (April to September) 20 were marked and 6 were recaptured. We found that the distance from the shore had a significant negative effect on the stranding probability, showing that turtles are more likely to strand when captured closer to the shore. Depth had no significance in the stranding probability and was dropped from the model. Season was also significant, showing that the stranding probability in cold months (mean=0.199; 95%CI: 0.042-0.438) are slightly lower than in warm months (mean=0.236; 95%CI: 0.128-0.363), these probabilities were calculated using the average distance from shore for each season. Between 2012-2016, the number of stranded turtles was, respectively, 38, 38, 71, 251 and 32 in cold months and 227, 145, 507, 431 and 473 in warm months. Using stranding probabilities for warm and cold months, the annual mortality estimates are 1300 (sd=377), 926 (sd=297), 2807 (sd=795), 3715 (sd=1580) and 2380 (sd= 649) for years 2012 to 2016, respectively. The large posterior standard deviations indicate that there is room for improvement if other informative covariates become available. We will test the inclusion of wind and sea current data as covariates in the models. Mark and recapture studies have become essential to more accurately estimate the mortality of endangered species from stranding data to subsidize conservation measures.

*RECORDS OF STRANDING SEA TURTLES IN THE NESTING BEACHES OF THE SOUTHERN NICOYA PENINSULA, COSTA RICA

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Accurate assessment of mortality rates of sea turtles and other marine megafauna based on the spatial distribution of dead animals is challenging. Even though sea turtle stranding data represent a fraction of actual mortality, it can provide useful insights on mortality trends. Understanding this mortality, especially if the origin is anthropogenic, is vital to assess the status of sea turtle populations and implement the necessary measures for effective conservation management. This study presents sea turtle stranding records collected from 1999-2022 along a strand of five nesting beaches of the Southern Nicoya Peninsula, Costa Rica (from North to South; Corozalito, Bejuco, San Miguel, Costa de Oro and Caletas). Data was gathered through night patrols and censuses, including location, date, species, sex, potential cause of death (visual inspection), Curved Carapace Length (CCL) and Curved Carapace Width (CCW). We recorded 340 sea turtles stranded over the 23-yr period, mostly during the rainy season (August-October). Of the three species identified, olive ridleys (*Lepidochelys olivacea*) were the most abundant (96.8%), followed by green turtles (*Chelonia mydas*) (1.8%) and hawksbills (*Eretmochelys imbricata*) (1.5%). Stranded olive ridleys were mainly adults, with an average CCL of 65.1 cm ± 17.3 (range 25-74.5 cm, n=218). Green turtle were all adults, average CCL= 74.9 cm ± 13.5 (range 65-100.7 cm, n=6). Only two immature hawksbills were measured (CCL=53.2 cm and 37 cm). It was not possible to record sex in 42.9% of the cases, when possible, males were predominant (54.6%). Cause of death could not be identified in 80.9% of the encounters, however, when identified (19.1%) anthropogenic factors (17.9%) were the main reason. Of these anthropogenic factors fishing interactions (54.1%) and boat strikes (36.1%) were the principal causes. Most strandings were reported in the two central beaches; San Miguel (38.8%) and Costa de Oro (30.6%), whereas events were less frequent at the northernmost and southernmost beaches, precisely where multiple use marine protected areas had been created by the Ministry of Environment limiting shrimp trawlers operations. Reports of stranded turtles have fluctuated over the years, with 2013 leading the count (11.8%), followed by 2020 (11.2%). The results of this study are consistent with the demographic structure of the olive ridleys that mate and nest year-round with a higher nesting activity during the rainy season. Juvenile hawksbills are known to inhabit the abundant rocky outcrops of the region, and adult green turtles to use the area as a "stop over" site during their migrations. Fishing interactions and boat strikes were the most common reported causes, although a greater cause could be forced immersion during shrimp trawl operations, hence the lower number of stranding reports near marine protected areas where the activity is banned. It is important to keep monitoring these minimum mortality as it provides insights regarding population structure and main causes, allowing for adaptive management.

DOCE RIVER MINING TAILINGS AFFECT LOGGERHEAD TURTLES' REPRODUCTION IN BRAZIL

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The Brazilian coast provides a suitable habitat for nesting sea turtles; however, some areas are increasingly exposed to environmental pollution from natural and anthropogenic sources. Added to that, in November 2015 a tailings dam ruptured in southeast Brazil, releasing mining waste that reached the Atlantic Ocean through the Doce river, affecting the second largest nesting site of loggerhead turtles (*Caretta caretta*) in Brazil. This study aimed to evaluate the reproductive success, and the heavy metal levels in female's blood, freshly laid eggs, unhatched eggs, and stillborn hatchlings of loggerhead turtles that nest in the coastal area exposed to the mining waste (Povoação, Espírito Santo state) and compare them with animals from an area that was not affected by the tailings (Praia do Forte, Bahia state). Blood concentrations of As, Cd, Cr, Fe, Pb, and Zn were significantly higher in samples from Povoação. After the incubation period (about 56 days), unhatched eggs and hatchlings that remained in the affected area had higher Cd, Cr, Fe, Mn, Pb, and Zn levels than fresh eggs, which reflects an important influence of the heavy metals from the sediment during this time. While in the non-affected area the only change was the levels of Cu and Zn that were higher after the incubation period. In loggerhead turtles from Povoação, non-essential metals like As, Cd, Hg, and Pb influenced the incubation time, hatchling success, and emergence success. Our findings strongly suggest that the higher levels of some metals in the blood and eggs are influencing the incubation period and hatchling emergence and success in this area. This scenario must call for the attention of environmental and health agencies and point to the direction that preventive measures related to pollution must be taken to prevent loggerhead population reproductive impairment.

LEATHERBACK INTERACTIONS WITH SMALL-SCALE ARTISANAL FISHERY FROM PUERTO LÓPEZ, ECUADOR

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Eastern Pacific (EP) leatherback turtles (*Dermochelys coriacea*) are critically endangered and population models suggest that they will go extinct within 50 years if radical reductions in fisheries bycatch mortality as well as increased protection of nests and hatchling are not implemented. Ecuador is important for the conservation of the EP leatherback as it hosts in-water foraging areas that overlap with intense fishing activity. Equilibrio Azul has worked for several years with artisanal fishermen from Puerto López a small fishing town located in Manabí province in south-central Ecuador and within the buffer zone of Machalilla National Park (MNP). Anecdotal data of interactions of leatherbacks with gillnets suggest potentially significant bycatch. From October 2017 to June 2019, we collected data of leatherback interactions with this artisanal gillnet fishery. Leatherback interaction data were collected in collaboration with crews of 12 artisanal fishing boats that provided data on fishing effort and interactions with leatherbacks (coordinates, photos and videos). The locations were mapped, and photo and video footages were reviewed to characterize leatherback interactions with fishing gear as well as observations of leatherbacks swimming near without becoming entangled, measure size, and assess if the animals were released alive and safely. Size was estimated using photogrammetry, where turtles were objects of known size were used from the

images. A total of 157 fishing trips were reported between October 2017 and June 2019 by 12 artisanal fishing boats from Puerto López. From these, 14 trips reported encounters with leatherbacks, representing 8.9% of the total trips, with a total of 15 leatherback individuals reported. Only 11 reports provided the exact location. The reports obtained confirmed that at least one leatherback died from entanglement in the gillnet (representing 7.1% of the leatherback encounters), and at least seven were released alive; the fate of the remaining seven turtles could not be confirmed from the footage provided. Locations varied from as close as < 1 km from the coast to as far as 180 km from the coast; at least six encounters took place close to the coast or to continental islands such as Isla de La Plata and Salango Island in MNP. At least three juveniles, one adult male and one female were identified. Six types of interactions were also identified from the images retrieved. The results obtained by this pilot project highlight the importance of working directly with fishermen, not only in terms of conservation, but as a novel way of collecting data that is otherwise extremely expensive and logistically challenging to collect, especially for female researchers. As part of this project, +/- 120 fishermen have been participating in leatherback conservation workshops and sea turtle safe-release workshops to reduce mortality in bycatch; some of them are participating in a pilot project of "responsible fish certification" to promote their efforts and provide a better source of income in return for their catch and continue to provide data of leatherbacks to the project.

REDUCING SEA TURTLE BYCATCH USING LED LIGHTS IN ARTISANAL GILLNETS IN PERU

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Bycatch in gillnets is one of the main threats over several species of marine megafauna that causes the reduction of their populations. In Peru, sea turtles are under catch pressure with diverse mortality rates. Bycatch Reduction Devices (BRD) for sea turtles include visual devices such as LED lights which act as a visual alert to see fishing nets, allowing turtles to avoid entanglement. The present study aims to evaluate the effectiveness of LED Lights to reduce bycatch of sea turtles in not previously tested artisanal gillnet fisheries in Punta Mero, Zorritos and Cancas in Tumbes region, Pucusana in Lima and Tambo de Mora in Ica. The LED lights tested were Netlight from Fishtek Marine company and were deployed in gillnet sets targeting species such as rays in Tambo de Mora, swordfish, and sharks in Pucusana, mobulas and sharks in Cancas and Zorritos, butterfish, Peruvian moonfish, Paloma pompano and Pacific sierra in Punta Mero. A total of 81 trips and 125 sets were conducted by 23 vessels from 5 artisanal fishing communities from September to November 2019 and from October 2021 to July 2022. For the tests, the gillnets were divided into three parts: a control zone (without LED lights), a buffer zone of 200 meters of length and an experimental zone (with LED lights) to evaluate the effectiveness of the LED lights. The results showed that there was evidence of a reduction of 43% in the bycatch of sea turtles in gillnets with LED lights (p-value = 0,0373). Turtles captured were mainly green turtles *Chelonia mydas* (93%) but also olive ridley sea turtle *Lepidochelys olivacea* (5%) and hawksbill sea turtle *Eretmochelys imbricata* (2%) were captured with 41% mortality rate of these sea turtles (17 individuals). We also observed that LED lights had no effect on the catch of the different target species. This result is consistent with other studies that tested LED Lights in Sechura, San Jose, Salaverry and Lima and helps complementing the larger scale needed to demonstrate the effectiveness of the device in different Peruvian gillnet.

SATELLITE-TAGGED GREEN SEA TURTLE CAUGHT BY LOCAL FISHERMEN AND RELEASED: AN ANALYSIS OF POST–INTERACTION MOVEMENT PATTERN AND BEHAVIOR

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On August 11, 2022, a juvenile Atlantic green sea turtle was equipped with a Wildlife Computers SPOT tag and released into the Atlantic Ocean from the southern coast of Long Island, NY. This individual had stranded during the 2021 cold stun season in NY and received nearly 9 months of rehabilitation at the New York Marine Rescue Center (NYMRC). Two months after release, the individual was snagged by a fishing hook in the pectoral flipper by a fisherman and released immediately. This interaction occurred more than 220 km from the original release location within the East River between the Whitestone and Throgs Neck bridges in NY which is 24 km from NYC. The event was not reported to NYMRC directly but discovered secondary when it was posted to a social media platform. In New York, sea turtles strand for various reasons including entanglement, vessel interaction, malnourishment/debilitation, and cold stunning with many cases linked to human activities and the overlap of shared resources between sea turtle and human populations. Using telemetry data, we examined the movement patterns prior to and following this interaction to provide insight on how subsequent human interactions can influence migratory behaviors.

*SELECTIVITY IN BEHAVIORAL RESPONSE TO PREY-LIKE PLASTIC BY SEA TURTLES

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Plastics are most abundant marine debris affecting wildlife. Globally, all seven species of sea turtles are affected by plastic debris. Also, about half of the global sea turtles were predicted to have ingested plastic debris. It is critical to figure out the ingestion mechanism by identifying how sea turtles react to plastic. However, the research on feeding behavioral response to plastic by sea turtles is very limited. Here, we studied how sea turtles respond to plastic exposure in aquarium tank. The experiments were conducted on three 4-year-old green turtles (*Chelonia mydas*) captive born in 2017 and eight 2-year-old hawksbills (*Eretmochelys imbricata*) in 2019. Green turtles are omnivorous in juvenile stage and change their diet to herbivorous properties in adult stage feeding on seagrass, marine algae, etc. Hawksbill turtles are omnivorous in whole life stage, especially spongivorous foraging sponge, jellyfish, etc. The plastic stimuli were chosen based on their similarity to real environmental prey. To adapt feeding on natural environmental prey, green turtles were provided with kelp (*Saccharina japonica*) once a week. Also, jellyfish (*Aurelia aurita*) were supplied to hawksbills every day for a week before first trial. For greens, ‘rope’, ‘micro-fouled rope’, ‘macro-fouled rope’, ‘kelp’, and ‘rope entangled with kelp’ were exposed stimulating visual and/or olfactory cues. For hawksbills, jellyfish, and film stimulants (white, transparent, and black plastic bag; red, and yellow packaging; blue bottle label) were exposed stimulating visual cues. Turtles were fasted a day or two prior to their experiment. The turtle’s behaviors were recorded in GoPro after the placement of stimulus. The trial began 3 min later with the turtle’s visual perception of stimulants.

Then, ten-minute break intervals last between trials. Sea turtle's responsive durations and frequencies were noted for the response indices such as their 'bite' and 'touch with snout'. For green turtles, duration was longest for kelp (89.3 ± 50.9 s), followed by rope entangled with kelp (58.1 ± 51.4 s), rope (7.77 ± 10.6 s), macro-fouled (2.5 ± 5.95 s), and micro-fouled rope (2 ± 4.29 s) (Kruskal-Wallis test, $p < 0.05$). Frequency was highest for rope entangled with kelp (7.83 ± 6.82), followed by kelp (6.93 ± 4.01), and others in 'bite and touch with snout' indices ($p < 0.05$). There were no significant differences between rope, micro-fouled, and macro-fouled rope. For hawksbills, they 'bit or touched with snout' more frequently and longer transparent (9.36 ± 11.3 s) and white (10.9 ± 24.5 s) than other film stimulants ($p < 0.05$). There was no significant difference between these light-colored plastic bag and jellyfish (15.9 ± 15.3 s). This study indicates that sea turtle responded more to plastic, entangled with food, or visually similar to food, hence, increasing probability of plastic ingestion in the marine environment. To reduce plastic ingestion, plastics visually alike sea turtles' food should be reduced in usage and production.

EXPLORING THE ROLE OF COLORS AS A CUE OF PLASTIC DEBRIS INGESTION BY SEA TURTLES

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Anthropogenic marine plastic debris is one of the global threats to marine wildlife. Ingestion and entanglement in plastic debris have been reported for more than 1,400 species, including endangered megafauna like whales and sea turtles, and the number of occurrences is constantly increasing. Sea turtle is one of the species considered an eligible indicator species of marine debris pollution. Despite many studies reporting plastic debris ingestion by sea turtles, however, the cues that attract them to ingest plastic debris remain poorly studied. Visual cues are considered to be of primary importance in the foraging behavior of sea turtles, and our previous study results showed that the most abundant colors of marine debris from the gut contents of the green sea turtles and loggerhead sea turtles were white and transparent, followed by green, mixed, yellow, black, which indicates that they may feed selectively. In this study, we aimed to figure out whether colors can influence the decision-making of their foraging behaviors in sea turtles. Specifically, we explored sea turtles' reactions to five different conspicuous colored jellyfish pieces (yellow, red, green, blue, and black) and one untreated jellyfish piece. To test this, we conducted experiments with green (*Chelonia mydas*, $n = 5$), hawksbill (*Eretmochelys imbricate*, $n = 11$), and loggerhead sea turtles (*Caretta caretta*, $n = 4$), and the sea turtles were simultaneously exposed to six jellyfish pieces of different colors. The order in which colours were eaten and the ingested colours were recorded. The stimuli presentation experiment was repeated three times for each sea turtle, and there was a minimum of 2 weeks between presentation trials. In most cases, turtles approached and began touching/biting the stimuli in a short time. Only 17% (10 of 60) of cases did not approach anything. There was no significant interaction between colour preference and species, so all data were analyzed at once without separating species. Sea turtles displayed a clear preference for untreated jellyfish piece when presented with six different coloured jellyfish pieces simultaneously. They were more likely to choose the untreated jellyfish first (Kruskal–Wallis test, $P < 0.05$, control vs all colours). We also observed the highest frequency of biting untreated jellyfish, and followed by yellow, black, red, blue, and green. This study would allow us to understand the role of colors in determining foraging behavior in sea turtles, and further understand the relationship between the attractiveness of plastics and sea turtles' preference for optimizing mitigation efforts to protect the marine ecosystem.

SHRIMP TRAWL FISHERY THREATENED ONE OF THE MOST IMPORTANT OLIVE RIDLEY POPULATIONS IN ATLANTIC OCEAN

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The olive ridley (*Lepidochelys olivacea*) population in Brazil is one of the most important populations in the Atlantic Ocean. On the last reproductive season, before Covid-19 pandemic (August, 2018 to July 2019), more than 12.000 nests were recorded. Almost all nests (95%) are located in the Sergipe and Bahia state, on the Northeast coast of Brazil. The Sergipe state has great importance for fishing, mainly shrimp trawl, gillnets and hook and line. The overlap between the intense fishing activity and the main nesting area for olive ridley turtle in Brazil has resulted on a high number of dead turtles with high reproductive value (adults). Between January 2008 and August 2022, close to 8.000 olive ridley turtles stranded dead along the Sergipe coast and 85.2% of them were adult turtles, including many females with eggs on oviduct (verified during necropsies). Aiming to identify which fishery most impact the olive ridley turtles on the region, the Fundação Projeto Tamar (FPT) performed a fishery monitoring program between September 2010 and June 2013. A wood boat with a 260 hp engine was used to cover 380 Km along the continental shelf, since the South coast of Alagoas state until the North coast of Bahia state, including all Sergipe coast. On total, 27 trips were performed, totalizing 179 days at sea. We registered all fishing boats found, mapped the fishing area and interviewed fishermen to characterize the fishery. In order to identify the olive ridley's habitat use, we attached satellite transmitters (model KiwiSat 101, Sirtrack) on 10 females from Sergipe rookery. Additionally, between October 2010 and June 2012, fishermen, voluntarily filled in forms provided by Fundação Projeto Tamar, to estimate the sea turtle incidental captures. Areas with high bycatch probability were defined as the areas where high density of fisheries overlaps with high densities of olive ridley turtles. Fisheries identified through the fishing monitoring program were: shrimp trawl (56%), hook and line (28%), gillnets (12%) and some fisheries less common during the survey, grouped here as: others fisheries (4%). The shrimp trawl exhibits high overlap with olive ridley's habitat, whereas the hook and line fishery and gillnet fishery, showed lower overlap. According to the forms filled in, 16 sea turtles bycaught in 3376 trawls. The estimated fishing effort for the 168 shrimp trawl boats registered in the area, suggests the capture of 621 to 1472 sea turtles annually. The incidental captures in shrimp trawl fisheries is the main threat to the olive ridley turtles in Brazil and must be urgently mitigated. In order to reduce the capture and death of olive ridley turtles we recommend: 1) an adjustment on TED's rules in Brazil, obligating the use of TED in all shrimp trawl boats, instead of only in boats bigger than 11 meters, 2) to establish a no fishing area between the north coast of Bahia until the south coast of Alagoas from November to March, overlapping with the peak of olive ridley nesting season in Brazil.

OPTIMISATION OF PACIFIC LEATHERBACK POPULATION VIABILITY ANALYSIS HIGHLIGHTS THE NEED FOR UNDERSTANDING PACIFIC FISHERIES BYCATCH

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The rapid decline of the Pacific leatherback populations has been attributed to anthropogenic impacts of unsustainable egg harvest and fisheries bycatch. Though decades of conservation have focused on the protection of nesting beaches and bycatch reduction, detrimental interactions with fisheries continue to exacerbate the decline of these populations. Population viability analysis (PVA) has been used in the East Pacific to guide conservation management decisions by allowing prediction of future population dynamics under varying conservation scenarios. This work updates the existing population viability analysis for the East Pacific population with comprehensive bycatch data sourced from a novel systematic literature review, and presents the first PVA for the West Pacific population. These analyses will inform stakeholder structured decision-making workshops, as experts work to identify the logistics required to take incremental steps towards bycatch reduction. By utilising technology and stakeholder expertise, the Pacific leatherback populations and other similarly imperiled species may be recovered before extirpation.

*ALTERNATIVE LOBSTER FISHING METHODS TO REDUCE HAWKSBILL SEA TURTLE BYCATCH

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The artisanal lobster fishery has been identified as one of the greatest threats to the hawksbill turtle in the Eastern Pacific (Gaos et al. 2010, Liles et al. 2011, Vega & Oaks 2011). Lobster fishers deploy gillnets almost exclusively in areas close to the coast, in neritic territories and on the migration routes of adult individuals, which increases the probability of interactions between *Eretmochelys imbricata* and fishermen (Gaos et al. 2012a). Considering the small size of the hawksbill population in this region, these threats could easily lead to the extinction of the species in the Eastern Pacific. To improve the survival of the hawksbill sea turtle, experimental designs have been developed to discover alternative lobster fishing methods that have a positive impact both on the capture of the target species and on the prevention of incidental capture of hawksbill sea turtles. During the first stage of the trial, we tried assorted designs of lobster pots, but the equipment was inefficient for capturing the targeted individuals. During the second stage, we tested the use of fishing nets with LED devices. This fishing technique has been effective in reducing sea turtle bycatch (>60% reduction) in several Eastern Pacific finfish fisheries, while still maintaining high (or better) catch levels of the targeted species (Wang et al. 2013). Because LED lights have given good results in other fisheries, we adapted the use of LED lights for lobster fishing methodologies in El Salvador. Preliminary results have shown an approximate 50% decrease in sea turtle bycatch while maintaining an approximate 8% improvement in catch of the target species. This effort is aimed at achieving a more sustainable lobster fishery hand in hand with the reduction of bycatch of hawksbill turtles.

*REVISITING LOGGERHEAD BYCATCH IN THE PERUVIAN SMALL-SCALE LONGLINE FLEET

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Loggerhead turtles have experienced a dramatic decline in nesting numbers and in recruitment of benthic foraging juveniles in the southwest Pacific. Fisheries bycatch has been recognized as one of the major threats faced by loggerhead turtles not only around nesting and foraging areas in the southwest Pacific but also on developmental grounds off Peru and Chile, in the southeast Pacific, where loggerheads migrate after hatching. Indeed, a previous study estimated that ~ 3,200 loggerhead turtles were captured annually in the small-scale longline fishery in Peru. In this study, we evaluated the current state of the interactions between small-scale longline fisheries and loggerhead turtles in southern Peru almost 10 year after the first study reported high capture rates. Data were collected through on-board monitoring of small-scale longline fishing trips from January 2018 to April 2019. Information was also compiled from volunteer fishers through participation in a citizen science sea turtle monitoring program. A total of 16 fishing trips and 185 sets were monitored by onboard observers and revealed that the longline fleet still interacts more frequently with loggerheads turtles than with other sea turtle species (i.e., green, olive ridley or leatherback turtles). However, the operation of longliners has changed over time. Fishers conduct more sets per trip and use fewer hooks per set during the dolphinfish season and more hooks per set during the shark season than before. Thus, longliners use more hooks per trip than previously and soaking times vary depending on the fishing season. Nevertheless, loggerhead captures reported in this study are lower than what was reported in 2011 (CPUE 0.35 vs. 0.63 loggerheads/1000 hooks and CPUE 0.07 vs 0.33 loggerheads/1000 hooks for dolphinfish and shark season, respectively). All turtles incidentally captured were juveniles (curved carapace length <70cm) and were released alive. Data collected by volunteer fishers while lacking detailed information as the onboard observer data were useful for obtaining location information and biometric measurements, and for tagging of a greater number of sea turtles than those reported by observers. Additionally, we found that volunteer fishers are most likely to provide bycatch data when it does not interfere with their fishing activities. Nevertheless, photographic reports confirmed that fishers were correctly taking biometric measurements, tagging, and using sea turtle safe handling and release methods. In general, small-scale longliners in southern Peru are still using the same fishing areas, gear and targeting the same species as they were 10 years ago, and the species composition of sea turtle bycatch remains similar. The change in fishing operations would have implied an increase in bycatch of loggerhead and other sea turtles, as more hooks per trip are being deployed now. However, our observer effort was small. Current efforts aim at expanding and continuing with the observer monitoring, which will allow us to confirm whether the pattern observed of lower loggerhead capture rates is also evident in a larger sample size. Continuous fishery-dependent monitoring efforts could allow us to better understand sea turtle population dynamics, especially when evaluating trends in capture rates of early life stages.

*GAS EMBOLISM IN MARINE TURTLES BYCAUGHT IN BOTTOM TRAWL FISHERIES IN THE SOUTH ATLANTIC OCEAN: AN IMPORTANT CONSIDERATION IN MORTALITY REDUCTION

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Gas embolism (GE) is the formation of intravascular gas bubbles and can lead to clinical signs and organ injury referred to as decompression sickness (DCS). These conditions have been documented in bycaught marine turtles that were forcibly captured at depth and brought to the surface. Our objectives were to 1) describe early occurrence and severity of GE and DCS in turtles bycaught in trawls using onboard clinical assessments during the first 1-2 hours after incidental capture; 2) provide an estimate of onboard and post-release mortality; and 3) evaluate the diving behavior of released turtles to assess their capacity to re-recompress and resolve GE. To date, 10 fishing trips have been completed with examination of 48 incidentally captured sea turtles. Of them, all ultrasound- or postmortem- examined turtles (39) developed GE independent of season, depth, duration of trawl, and ascent speed. Gas emboli were observed by ultrasound within as little as 15 minutes after surfacing, and worsened over the course of 2 hours on deck. Blood work indicated turtles experienced extreme metabolic derangements. Following captures, 20 of 48 animals died on board and 26 were active (as assessed by the observers) and released with satellite tags. Seven of the tagged turtles died within 30 days. Future work will include detailed analysis of dive profiles obtained from 11 turtles during the first 2 days post- release. These results demonstrate profound implications of trawling fisheries on sea turtle populations and indicate DCS and associated mortality should be considered in the bycatch mitigation measures.

ENTANGLEMENT OF SEA TURTLES: RISK FACTORS, HEALTH IMPACTS AND INFLUENCES ON SUCCESSFUL CONSERVATION OUTCOMES, FROM THE OLIVE RIDLEY PROJECT IN THE MALDIVES, INDIAN OCEAN

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Five out of seven sea turtle species can be found in the Maldives: hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*), olive ridley (*Lepidochelys olivacea*), loggerhead (*Caretta caretta*), and leatherback (*Dermochelys coriacea*) sea turtles. All are listed on the International Union for Conservation of Nature (IUCN) red list of threatened species, as vulnerable to critically endangered. Globally sea turtles face a range of threats, including climate change, habitat degradation, pollution, poaching and entanglement in marine debris. Entanglement occurs when marine animals become entangled in anthropogenic material, most commonly abandoned, lost or discarded fishing gear (ALDFG) also known

as 'ghost gear'. With five years of accumulating data from our Marine Turtle Rescue centre we have attempted to identify potential risk factors and health impacts associated with entanglements, investigate cases with buoyancy syndrome, and assess rehabilitation outcomes. The results could be used to develop conservation strategies to improve sea turtle health in an ecological context, manage and/or mitigate risk factors and to improve animal welfare on many levels from individual turtles to populations. Retrospective analysis was carried out on patient record data from the Olive Ridley Project Marine Turtle Rescue Centre in Baa Atoll. Quantitative statistical data analysis were carried out using R studio software; to allow investigation into variables, data manipulation and visual representation of results. Results show entanglement was the most common cause for turtle rescue, with ghost nets involved in the majority of these cases. Entanglement is significantly associated with flipper injury, and has a high association with the requirement for amputation surgery. Most entanglement cases have been successfully released following rescue and rehabilitation. In contrast, buoyancy syndrome was significantly associated with the final outcome of turtles being deceased. In conclusion, the results highlight the importance of eliminating entanglement risks at the source. Further research is needed to establish any cause and effect relationship between entanglement and buoyancy\ syndrome.

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*ODORS FROM MARINE PLASTIC DEBRIS ELICIT FORAGING BEHAVIOR IN SEA TURTLES

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Marine plastic debris poses a global threat to marine turtles, largely through fatal ingestion and entanglement. However, the sensory mechanisms that drive these harmful interactions remain poorly understood. Recent discoveries show that the same olfactory infochemicals used by marine predators to both identify suitable prey and locate areas of elevated ocean productivity also emanate from marine-conditioned plastic debris, providing both proximate and long- distance sensory cues that may facilitate fatal interactions with plastic debris. We tested whether odors emanating from marine-conditioned plastic debris elicit foraging behaviors in oceanic- stage loggerhead sea turtles (*Caretta caretta*). Results from standardized odor-response experiments indicate that turtles respond to odors from marine-conditioned plastic debris and their food with a similar intensity of distinct foraging behaviors, while showing no response to odors from controls. The keystone infochemical dimethyl sulfide elicited an intermediate response, suggesting that additional chemical constituents may enhance attraction to marine-conditioned plastic. These results provide the first experimental evidence that olfactory infochemicals can attract sea turtles to marine plastic debris, facilitating opportunities for fatal ingestion and entanglement. Understanding such ‘sensory traps’ experienced by marine turtles is critical for optimizing mitigation efforts.

*ARTISANAL LOBSTER FISHING AND ITS RELATIONSHIP WITH THE HAWKSBILL TURTLE IN LOS CÓBANOS COMPLEX NATURAL PROTECTED AREA AND PUNTA AMAPALA, EL SALVADOR

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The hawksbill turtle (*Eretmochelys imbricata*) has a wide distribution, being found in tropical waters of the Indian, Pacific, and Atlantic oceans, in which they frequent shallow waters and coral reefs in search of food such as sponges and other marine organisms. In El Salvador, hawksbills use rocky reefs located in Los Cóbanos Complex Natural Protected Area, Sonsonate and Punta Amapala, La Unión. The hawksbill turtle shares a habitat with a variety of marine species such as mollusks and crustaceans. This living space is used as a feeding, resting and shelter site. Lobster are included within this other species that share a space with hawksbill turtles and that's why they are bycatch in this fishing art. Artisanal lobster fishing in Los Cóbanos and in Punta Amapala relies on gillnets (300m x 1m) with mesh sizes that vary from 2.5 to 5.0 centimeters; although the number of nets, weights and buoys can vary depending on the fishing area, as well as the depth of net deployment, which ranges from four to 25 meters. ProCosta Association has implemented a project called Lobster Observations in Punta Amapala since 2015 and Los Cóbanos since 2018, which aims to collect information on lobster fishing and hawksbill bycatch. Collected data include the date of setting and hauling nets, net soak times, number of individuals caught, total weight of the task, lobster length, geographic coordinates, depth, water temperature and records of hawksbill sea turtle bycatch in which mortality and morphometric data such as Length and Curved Width of the Carapace (CCL and CCW) are noted. All this information is compiled with the help of local fishermen teams, with three teams operating in 2015 to 2017, and 12 teams operating since 2018 in Punta Amapala. Fishing information has been collected in Los Cóbanos since 2018, through the involvement of seven teams. From January 2015 to July 2022, a total of 192 hawksbill turtles have been incidentally captured in lobster gillnets, with 183 in Punta Amapala and 9 in Los Cóbanos. From all the hawksbill turtles captured, 169 turtles were dead and only 23 were found alive and then returned to the sea. The average CCL of the captured turtles is 40.26 centimeters. These results show the vulnerability of the species in its first stages of life, as most individuals captured in lobster gillnets are in juvenile stages, which puts the survival of the species at risk since individuals lose the opportunity to reproduce. Due to the high impact of lobster nets on non-target species and marine ecosystems, the incorporation of more selective fishing gear or methods and the regulation of existing fishing gear is urgently needed.

SIZE DISTRIBUTION AND KEY FEEDING HABITAT FOR LOGGERHEAD TURTLE (*CARETTA CARETTA*) IN THE GULF OF VENEZUELA: UNDERSTANDING RECRUITMENT PROCESS AT THE SOUTHERN CARIBBEAN

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Demographic models for loggerhead sea turtles indicate that population growth is sensitive to mortality of subadult size class in the feeding habitats, and that these turtles prefer ecosystems with strong upwelling as feeding zones. The Gulf of Venezuela (GV) is one of the main feeding zones for sea turtles in both Venezuela and the Caribbean. Nevertheless, at least 625 turtles are killed each year by turtle hunters from this area. This research aimed of identify the sizes and distribution from strandings of loggerhead turtles in GV. We considered stranding whatever event where some individuals may be attached to fishing nets, biting baits or dead at the shore. For the study area, we covered 160 km of the shore line of GV, going from the northeast to the southeast, between the beaches of Quisiro and Castilletes, starting in 1987 until July 2017. We registered a total of 61 Loggerhead turtles, from which 64% were classified as immature individuals, 18% as adults and the last 15% could not be identified properly. From the whole area of study, this species had the highest frequency of events in the low and mid Guajira zone. Most of the strandings were product of artisanal fishing. The GV presents one of the most significant upwelling areas along the shore of Venezuela, and the pattern of the currents matches exactly with the high frequency locations of strandings. At the same time, the months with highest frequency of strandings were the months with the highest levels of upwelling. Between 147 and 490 individuals of this species die per year interacting with fishing gears. Finally, it is a priority to protect this zone and understand the real value of the population of loggerhead turtle in the Gulf of Venezuela. New strategies for environmental protection, from multiple stakeholders should focused on these key habitats.

*BEHAVIORAL RESPONSES OF SEA TURTLES TO EVADE ENTANGLEMENT IN FISHING NETS

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Numerous anthropogenic hazards in the ocean, especially those associated with fisheries, can cause mortality or sublethal effects to sea turtles. Bycatch, or the incidental capture of non-target species in fisheries, is a major threat to sea turtle populations worldwide. Here, we measured sea turtle behavior in relation to gillnet fishing gear by recording interactions of wild-caught juvenile green and loggerhead turtles with modified gillnets during controlled trials in a 13.9 x 2.3 x 1.5 m tank at the St. Lucie Nuclear Power Plant, Jensen Beach, Florida. We identified two previously undescribed evasive maneuvers that

both green and loggerhead turtles exhibit in the presence of gillnets. A “reversal” behavior was characterized as contact with the gillnet followed by backward movement while maintaining forward orientation. A “U-turn” behavior was a quick 180-degree pivot before making contact with the gillnet or other barrier. Reversals were more frequent at night than during the day for both species. Green turtles exhibited significantly more “U-turns” and overall net interactions than loggerheads, but loggerheads were more likely to become entangled in the net. Both species were more likely to become entangled at night than during the day. These findings support the hypothesis that sea turtles detect gillnets either visually or tactilely but may not perceive them as impassable barriers. Findings also support the assumption that sea turtle movements rely on visual cues, which may result in more risk of bycatch at night. The “reversal” and “U-turn” behaviors are evidence of sea turtles’ potential to avoid entanglement. Our experimental approach is a promising method to “fine tune” bycatch reduction techniques for gillnet fisheries worldwide. We propose that developing an understanding of sea turtle behavior, including attraction, avoidance, and detection, in relation to fishing gear during both day and night periods, informs the most effective path toward improved sea turtle bycatch reduction technologies.

ESTABLISHING A NOVEL APPROACH TO DOCUMENT SEA TURTLE BYCATCH IN FISHERIES OFF THE PACIFIC OF PANAMA AND COLOMBIA

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The accidental capture of non-target species in fishing gear—or bycatch—has led to the decline of several sea turtle populations, and effective management and bycatch mitigation programs are necessary to stabilize the population trends. In general, research efforts have been focused on regional frameworks and large-scale industrial fisheries, given their ease of logistics and centralized infrastructure. However, local bycatch assessments allow the description of fine-scale patterns essential to effective management and provide insight into the complexity of bycatch impacts on sea turtles related to local oceanographic characteristics, fishing gears, habitat use, and behavior of the species in certain life stages. The Pacific waters of Panama and Colombia have been recognized as data deficient on bycatch for sea turtles, and there is an urgent need to fill these data gaps to build consistent bycatch management programs. With this in mind, we designed a novel study to understand for the first time the spatial-temporal sea turtle bycatch trends along the area. The study incorporates data collected voluntarily by fishers and data collected through a newly established small-scale fisheries observer program, plus artisanal and industrial fisheries monitoring data provided by government agencies and private fishing companies. In 2017 we established collaborative relationships with artisanal fishers from several communities in both countries to promote data sharing and implementation of fishing practices to minimize the impacts of interactions on survivability of released individuals. From this collaboration and for two years, a group of 50 fishers reported opportunistically the coordinates and pictures of bycaught sea turtles on gillnets and longlines. In 2018, we established a pilot fisheries observer programs in Colombia, four fisheries observers operating from Bahía Solano (1), Buenaventura (1), and Tumaco (2) collected information on turtle catch composition and biometric data. In addition, observers collected detailed data on target species, catch composition, and fleet characteristics (i.e. gear type, spatial and temporal trends in fishing effort). Data were compiled into maps illustrating species-specific bycatch for different fishing gear types, and trends in

bycatch relative to bathymetry, sea surface temperature (SST), surface chlorophyll *a* concentration, sea surface height anomaly (SSHa), and geostrophic velocities. This work represents the first comprehensive and multidisciplinary approach to understand the nature and frequency of sea turtle bycatch in the Pacific waters of Panama and Colombia.

CONSERVING THE EASTERN PACIFIC LEATHERBACK SEA TURTLE: THE SOLUTION LIES IN ARTISANAL FISHERMEN NETWORKS

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Leatherback turtles (*Dermochelys coriacea*) traverse the ocean in pursuit of feeding and nesting grounds. Throughout the East Pacific region, the species has been observed in the last few decades by fishermen. Leatherback turtles specialize in feeding on jellyfish that naturally coexist in large blooms and in oceanic upwelling zones of high primary productivity. These zones often overlap with fishing sites for artisanal fishermen who depend on fishing for their daily sustenance. Fisheries bycatch is considered to be the major cause of the rapid decline of East Pacific leatherbacks. Although there are many international organizations that promote the conservation of this species, such as the Laúd OPO Network and the International Union for the Conservation of Nature, in-water conservation work focused on the leatherback turtle is challenging. An overall lack of understanding of this subpopulation's movements throughout the East Pacific during its different life stages and temporal migrations adds to this challenge. There is a need for long-term, in-water monitoring programs in each country in the region to better understand the seasonal movements of leatherbacks in coastal and pelagic waters. This goal cannot be realized without the consistent involvement of fishermen in data collection and conservation programs. In 2019, The Leatherback Project began collaborating with fishermen in Ecuador and Panamá to document fisheries interactions and sightings of the leatherback turtle in national and international fishing grounds. We conducted structured interviews with 117 artisanal and semi-industrial fishermen in Ecuador and 121 artisanal and semi-industrial fishermen in Panama between 2019 and 2022. Our objectives were to understand the habitat use of leatherbacks, find potential hotspots of fisheries interactions, understand the ecological knowledge of local fishing communities, document the effects of fisheries bycatch on local communities, and gauge the interest of fishermen in collaborating in bycatch reduction strategies. These surveys sparked many long-term collaborations with individual fishermen and fishing cooperatives, and since 2019, 17 leatherback fisheries interactions with fishermen have been documented, two of which resulted in leatherback mortality and 15 of which resulted in the live release of leatherbacks. The team presents the preliminary analysis of these survey data, showing seasonality, spatial distribution, gear type (artisanal gillnets and longlines and semi-industrial longlines and purse seines), and condition, gender, and life stages of captured individuals. In Ecuador, 60.5% of fishermen had experienced fisheries interactions with the leatherback and 10% of interviewed fishermen were interested in participating in conservation efforts for the species. The network of fishermen that have collaborated with The Leatherback Project have provided data and testimonies that are invaluable to our efforts to prevent extirpation of this species in the East Pacific. We propose the development of national and regional fishermen networks to support fishermen in their data collection and conservation efforts, standardize reporting, share ecological knowledge, brainstorm broad-scale conservation initiatives, and decrease sea turtle mortality due to fisheries bycatch.

*MARES COMUNIDAD: WORKING WITH LOCAL COMMUNITIES IN PACIFIC MEXICO TO REDUCE SEA TURTLE BYCATCH AND IMPROVE HUMAN WELL-BEING

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Fisheries bycatch mortality is one of the largest impediments to recovery for sea turtle populations across the globe. While there are many paths to solve the bycatch issue, such efforts are most successful, and have the greatest chance of long-term adoption, when fishers and communities are engaged in a meaningful way from the start when developing bycatch reduction strategies. Moreover, when bycatch reduction is part of a holistic effort that also fosters alternative livelihoods, fishers face less pressure to fish long hours at sea, which benefits fishers, their families, and human well-being in general. In 2020 a new free-trade agreement among Mexico, the United States, and Canada was ratified, effectively replacing the North American Free Trade Agreement (NAFTA). This new accord—the USMCA Trade Agreement—includes several environmental goals, one of which is to develop a comprehensive program to reduce fisheries bycatch of the two most endangered sea turtle species in Pacific Mexico, the loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*). Known as *MarEs Comunidad* (marescomunidad.com), this initiative involves numerous government, academic, and NGO stakeholders in the U.S. and Mexico, as well as fishers and fishing communities that directly interact with turtles. The main goals are to promote sustainable fishing practices and livelihood opportunities in coastal communities throughout Pacific Mexico and the Baja California Peninsula. The framework for these efforts includes rapid bycatch assessments (RBAs) in coastal communities, fisher engagement in high-bycatch areas to learn their ideas on how best to reduce bycatch, at-sea gear trials to identify new turtle-friendly fishing techniques, promotion of alternative livelihoods to reduce heavy fishing pressure, and constant internal and external evaluation of project management and milestones. So far, more than 270 RBA interviews have been conducted across 28 communities in six states; these have been followed by workshops with fishers from more than 10 communities across mainland Mexico and the Baja Peninsula. Experimental gear trails have been ongoing in two—soon to be three—communities to evaluate the efficacy of various gillnet configurations for reducing turtle bycatch while maintaining target catch rates. Efforts have also fostered alternative income opportunities stemming from community interests. This presentation summarizes activities of *MarEs Comunidad*, highlighting successful strategies and lessons learned. We propose a framework for community-based sea turtle bycatch reduction efforts that can be applied elsewhere. We also present methods for promoting alternative livelihoods that will further enhance sustainable fisheries and hopefully improve human well-being. In closing, we acknowledge that this initiative is only possible thanks to the willing involvement of coastal communities and fishers throughout Pacific Mexico; we profoundly appreciate their support.

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*DEVELOPING SOLAR-POWERED NET ILLUMINATION TO REDUCE SEA TURTLE BYCATCH

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Gillnet fisheries are globally ubiquitous and vital for food security, nutrition, and livelihoods in coastal areas throughout the world's oceans. However, these fisheries incur high bycatch of sea turtles that can lead to costly fisheries restrictions that result in important revenue losses in coastal communities with scarce economic alternatives. Over the past decade, net illumination – via battery-powered light emitting diode (LED) lights or chemical light sticks – has emerged as a potential solution to reduce bycatch of sea turtles in coastal gillnet fisheries while maintaining target fish catch. However, batteries in existing LEDs need to be changed bi-weekly to monthly to maintain their effectiveness and chemical light sticks last for only 24 h, creating recurring costs for coastal fishers and concerns over battery disposal and marine pollution. In partnership with coastal fishers, we developed solar-powered net illumination by creating a buoy that houses a flexible solar cell, rechargeable lithium-polymer battery, and two green LED light-strips. The lighted buoy is constructed of a polycarbonate housing which allows for the integration of electronics for charging and discharging. The lighted buoy can self-charge in sunlight and be programmed to automatically emit static or flashing light, while remaining illuminated for up to a week with approximately 60 minutes of direct sunlight. In contrast to existing LEDs which require a complex locking mechanism to replace batteries, our design is sealed and can run for years without opening. Using controlled experiments, we tested the solar-powered lighted buoys with flashing green light (5 Hz (10% duty cycle); 20 m on, 180 m off) on sea turtle bycatch and target fish catch in the Gulf of California, Mexico. We found that the solar-powered lights significantly reduced sea turtle bycatch while maintaining target fish catch and value. Our results suggest that solar-powered net illumination and the use of flashing light represents a promising sea turtle bycatch mitigation solution with global applicability.

IMPACTS OF ANTHROPOGENIC VARIABLES ON SPATIAL PATTERNS OF SEA TURTLE NESTS: WATAMU BEACH

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Sea turtles are one of the marine species that utilize the Kenyan cost as a nesting site. The choice of a nesting site where eggs are laid by the turtle is influenced by the varying anthropogenic variables along a given beach. Such variables include location of hotels and the existence of lights on the beach and other human activities on a beach. All sea turtle species are listed as endangered or threatened under the Endangered Species Act. Globally sea turtles face a number of natural and anthropogenic threats to survival, including loss of habitat, nest predation, marine pollution, and the commercial fishing industry. (L. Hall, 2014). turtles prefer to nest in areas that possess specific beach qualities such as gentle slope, moderate vegetation cover, absence of barriers and pollution, medium sized sand particle, darkness and little human disturbance (whiting et al, 2014). Apart from the few hotels that interfere with darkness and increase human activities on Watamu beach, the other qualities; gentle slope, moderate vegetation cover, absence of barriers and pollution and medium sized sand particles (Fridah et al.,2019) characterize the beach and make it a suitable nesting area for sea turtles. An assessment of the distribution and status of critical nesting habitats and their protection both current and anticipated threats is crucial to the conservation of turtles. This is because management decisions must include precise assessment of population size, including determination of whether populations are stable, increasing, or declining. The Marine Turtle Conservation Strategy and Action Plan for the Western Indian Ocean which includes the Sodwana Declaration, tasked Kenya to identify nesting and foraging habitats so as to assess, monitor, and regulate fisheries impacts on turtles and such analysis as point pattern analysis will help address the question on nesting habitats by identifying the nesting g patterns on selected beaches. The objectives of this study were to elaborate on the use of point analysis to explain the current trend of nesting turtles in Watamu beach and identify the attached anthropogenic causes to the patterns. Kernel density analysis was used and showed that the 2022 nest locations inclined to the south of Watamu beach. This is due to different forms of coastal development, and lighting at the northern end of the beach where most hotels are located. These observations emphasized the importance of long-term and consistent monitoring of sea turtle nesting sites. The outcome remains key in informing management interventions to conserve and protect nest sites of along Watamu beach.

*INTERACTIONS OF MARINE TURTLES IN FLORIDA'S COMMERCIAL AND RECREATIONAL TRAP FISHERIES: 30+ YEARS OF DATA REVEAL A WIDESPREAD AND PERSISTENT THREAT

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Incidental bycatch is considered to be among the most significant threats facing marine turtle populations. To date, the majority of marine turtle bycatch research has focused on trawl, longline, and gillnet fishery interactions. In contrast, the impacts of trap fisheries on marine turtles have received comparatively little attention. Florida is an epicenter for commercial and recreational trap fisheries which overlaps with extensive marine turtle nesting and foraging habitats, and is therefore a critical location for assessing the threat that trap fisheries may pose to turtle populations. Drawing on a 30+ year dataset from Florida's Sea Turtle Stranding and Salvage Network (STSSN), we describe the first robust assessment of marine turtle interactions in Florida-based trap fisheries. In 450 recorded interactions, five species comprising loggerhead (51% of interactions), green (28%), leatherback (17%), Kemp's ridley (3%), and hawksbill (1%) turtles were documented in three trap fisheries – commercial Caribbean spiny lobster (44% of records), both commercial and recreational stone crab (38%) and Atlantic blue crab (16%) fisheries, and also research/volunteer bay scallop (3%) cages. Clear spatial delineations by fishery were observed, with lobster trap entanglements occurring primarily in the Florida Keys, stone crab trap entanglements occurring primarily in the southwest Gulf coast, blue crab trap entanglements occurring primarily off the Atlantic coast, and scallop cage entanglements occurring exclusively in the Panhandle. Entanglements occurred year-round in all turtle species and showed no consistent temporal patterns. Leatherback turtles were primarily reported in the southwest Gulf stone crab fishery and appear to be disproportionately entangled in comparison to statewide annual nest counts, warranting further research on how trap design and placement may affect leatherback interactions. Given the ubiquity of entanglement records across Florida, coupled with most entanglement events being reported in the absence of a recognized on-the-water observer network, the threat posed to marine turtles by trap fisheries is likely substantially underreported and underrepresented. Moreover, entanglement in the stone crab fishery may pose a serious threat to leatherback turtles off Florida's Gulf coast.

FORAGING HABITAT USE AND PLASTIC INGESTION OF GREEN AND HAWKSBILL TURTLES IN THE RED SEA

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The Red Sea is a relatively understudied marine ecosystem, and this is especially true for its megafauna populations, including sea turtles. The lack of data on sea turtle habitat use patterns and how these relate to anthropogenic threats is a hindrance to effective management and conservation efforts. Here, we studied plastic ingestion and movement patterns of both green and hawksbill turtles in this region. Necropsy data was collected from ten specimens found dead along the Saudi Arabian coastline. We found large plastics (> 1 mm) in 40% of the necropsied turtles, including one that had ingested a 3.51-meter-long strand of fishing line. Furthermore, we satellite tracked five green and three hawksbill turtles to quantify their respective home-range and core-use areas of foraging sites to assess the feasibility of spatially targeted mitigations. Foraging habitats were highly constrained with an average core use area of 27 km^2 (range: 0.16 – 154.20 km^2). The findings here demonstrate that plastic ingestion is a threat within the Red Sea, one that can lead to mortalities of both juvenile and adult turtles. However, given the high fidelity of tracked turtles, we suggest that spatially targeted mitigations, such as beach or reef clean-up efforts at known foraging areas, could be a cost-effective strategy. Finally, we suggest longer-term solutions should be considered, such as implementing better waste management systems to prevent plastics from entering the marine environment in the first place. This is crucial as the population around the Red Sea is expected to double within the next 30-40 years, and there are large-scale coastal development projects underway in northern Saudi Arabian waters that may add additional pressures on the environment.

ADVANCING EMERGING GEAR MODIFICATIONS TO MITIGATE SEA TURTLE BYCATCH IN GILLNET FISHERIES

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The unintended capture (i.e., bycatch) of sea turtles, marine mammals, and seabirds in fisheries is a pressing global conservation concern. Fishing with unselective gear, such as with gillnets that are commonly used in artisanal fisheries, exacerbates bycatch rates. Illuminated gillnets and gillnets with reduced vertical profiles have previously shown encouraging results to reduce bycatch of threatened species while maintaining fish catch and value. However, further research is needed to understand how these approaches can be improved to achieve greater catch selectivity and efficiency. Correspondingly, in partnership with several local fishers in the Gulf of California and the Pacific coast of Mexico, we are developing and testing three different in-situ experiments. We are further exploring: 1) buoyless gillnets; 2) low-profile gillnets; and 3) the spacing of lights in illuminated gillnets to reduce bycatch rates, especially of sea turtles, without affecting fisher productivity. In each of the three experiments, control and modified nets will be used to collect and compare discarded and retained bycatch rates, target catch rates, target species market value, species catch composition, and operational efficiency (hauling and sorting time). By collaboratively working with local artisanal fishers, we are able to incorporate their feedback and perspectives directly into our experimental designs and executions. Our findings will provide insights on how to further mitigate bycatch through different modified fishing gear, such as the application of technical gear modifications and gear technologies.

*MAPPING SEA TURTLES VULNERABLE TO VESSEL STRIKES WITHIN REGIONAL, NEARSHORE, HOTSPOTS IN FLORIDA, USA

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Vessel strikes are a major source of mortality for threatened and endangered sea turtles. Knowing when and where sea turtles are most vulnerable to vessel strikes can help managers reduce this threat. We surveyed standardized transect lines to create a distribution map displaying where Loggerheads and Green Turtles are most vulnerable to vessel strikes off Florida's (USA) Atlantic coast during breeding seasons in 2021 and 2022. Survey data were analyzed by Distance Sampling and Density Surface Modeling to estimate near-surface (vulnerable) turtles as a function of several covariates. Vulnerable turtles were clustered near shore and within hotspots described by adjacent nesting beach density at a scale of tens of kilometers. These results differ from descriptions of strike- risk potential based on stranding data. We propose that the methods and data products we present are useful for the human behavior change required to reduce the widespread risk of vessel strikes on sea turtles.

ASSESSING THE POTENTIAL EFFECTS OF VARYING LEVELS OF MARINE PLASTIC POLLUTION IN THE NESTING HABITAT OF LOGGERHEAD TURTLES IN BOA VISTA ISLAND, CABO VERDE

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The Cabo Verde Islands are the third largest rookery for loggerhead turtles (*Caretta caretta*) in the world, with the most easterly island of Boa Vista hosting 60–70% of all nesting activity. This population has been categorised by IUCN as Endangered with major threats to this population identified as bycatch, poaching, habitat loss and destruction, and adverse effects of climate change. Whilst ingestion of plastic in turtles is a popular research topic, the study of impacts of plastic on turtle nesting activity and their habitats is virtually non-existent. The northern and eastern coast of Boa Vista is a recognised hotspot for nesting loggerhead turtles; however, it is also subjected to deposits of vast quantities of marine waste carried via the Canary Current and north-eastern trade wind. This two-part study tries to identify and evaluate potential impacts on the behavioural ecology of nesting turtles and the nesting success and subsequent viability of clutches laid along the northern coast. The first part of this study looked at the distribution and abundance of both loggerhead turtle nesting activity (data from 2017–2020) and marine plastic pollution (data from 2019–2020) along the northern coast of Boa Vista (20.5 km x 100 m of coastal habitat). Commercial drones were deployed to take high resolution images which were later analysed using QGIS and individual pieces of plastic >20 cm in size were identified, assigned a GPS location and categorised (n = 116,907). Daily patrols were conducted during the nesting season and GPS location data and type of nesting activity (nests, false crawls and false crawls with attempts) were recorded (n = 25,045). Both plastic and turtle activity abundances and distributions were compared across 20 km of coastal habitat. The second part of this study included a qualitative in-situ study conducted from July to October 2022 which evaluated the hatching success of n = 21 nests and samples of sand taken at incremental depths directly above the nest. 65 days after laying, a 1 m x 1 m quadrat 2 cm deep (0.02 m^3) was sampled with the nest located at the centre. Additionally, 250 cm^3 samples were taken according to previously defined protocols at depths of 2–10 cm, 10–20 cm, 20–30 cm, upper nest and lower nest. The samples were subsequently processed and analysed according to type, length and mass of plastic at each depth. Preliminary results found that the turtle nesting activity was indeed affected by the density of plastic items present and the viability of clutches decreased as the amount of plastic found in the vicinity of the nest increased. If the preliminary results are confirmed, this has conservation implications such as directing national and international funds to reducing the type and quantity of plastics reaching nesting beaches and introduction of thorough "cleaning" of nesting and/or hatchery areas to improve hatching success rates.

MONITORING SEA TURTLE HARVEST IN THE SEA IN OF ONE OF THE MOST IMPORTANT NESTING SITES IN EASTERN INDIAN OCEAN: AN ASSESSMENT FOR FURTHER CONSERVATION MEASURES

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Bangkaru island (Aceh, Indonesia) is among the most significant nesting sites of endangered green turtles (*Chelonia mydas*) in Indonesia. Every night throughout the year, up to ten individuals come to the beach to lay eggs. Leatherback turtles (*Dermochelys coriacea*), whose Indian Ocean subpopulations are critically endangered, lay eggs on this site from November to January. Hawksbill turtles (*Eretmochelys imbricata*, critically endangered) do not nest on Bangkaru Island. However, they can often be spotted in the sea around the island. The conservation efforts on the island started at the end of the 1990s, and since then, several NGOs have managed sea turtle monitoring and conservation programs at the site. In the past, egg poaching was a severe threat to the nesting turtles (in 2016, at almost 100% poaching rate of nests on the island). Nowadays, egg poaching is no longer posing a severe threat. Unfortunately, the direct harvest of sea turtles in the sea continues. We decided to monitor the situation more closely and recruited local informants to help us monitor the situation. Furthermore, we initiated the sea patrols (from November 2021) and gradually tried different strategies to tackle illegal fishing practices and sea turtle harvest. We collected data on the frequency of sea turtle harvest. When possible, we recorded data on the volume of harvested sea turtles, species harvested and carried out carapace measurements, or developmental stages (juvenile, adult). In the case of trade, we recorded the final destination. We have found that the sea turtles were harvested by several fishermen irregularly, but we recorded several harvests each month. Mainly green turtles were harvested, but we also recorded the harvests of hawksbill turtles. The harvested volume of sea turtles differed from one to ten individuals per boat. Harvested were sea turtles of all developmental stages. Only a small part of the sea turtles was for local consumption. Most of the harvested sea turtles were traded to Nias to meet the turtle meat and tortoiseshell trade demand. In Nias, local communities still find sea turtle meat a favorite delicacy. Moreover, Nias is considered one of Indonesia's largest tortoiseshell trade hotspots. Our monitoring showed that the direct harvest of sea turtles on the sea can have a significantly negative impact on the nesting site protection efforts, and new strategies for more complex sea turtle protection in Bangkaru are now under development. We hope that the results of our monitoring and lessons learned from this case have the potential to help with the initialization of similar activities in other areas where sea turtles are threatened with direct take in the sea despite the conservation of the nesting sites.

IN-WATER BIOLOGY (BEHAVIOR, ECOLOGY, MIGRATION, TELEMETRY, FORAGING)

*HABITAT USE OF TURTLES, SHARKS, AND RAYS ACROSS A HETEROGENOUS LANDSCAPE OFF SAONA ISLAND

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Saona Island, located in the Dominican Republic, is an understudied region for sea turtles in the Caribbean and we know little about the local population's behavior and habitat use. Saona Island is known for its adjacent coral reef, seagrass, and mangrove habitats that are equally accessible to sea turtles for foraging and resting. During the months of May and June 2022, we collaborated with local fishers to quantify sea turtle densities across coastal seagrass and coral reef habitats. We quantified sea turtle abundance across habitat types using preprogrammed aerial video surveys with a DJI quadcopter drone. We conducted 2 surveys per day within 6 different time blocks that ranged from 7 am to 5 pm. For accuracy of detection, 13 independent human observers watched each video to count the number of turtles, rays, and sharks in each drone transect. We had a total of 96 sightings of turtles, rays, and sharks with an average of 4.73 observers sighting each animal. We found mean sighting densities of 45.73 turtles/km2, 69.34 rays/km2, and 26.55 sharks/km2. Turtles were primarily observed over seagrass habitats while rays and sharks were primarily observed over seagrass and shallow waters adjacent to mangroves respectively. Our results provide the first in-water sea turtle abundance estimates off Saona in 17 years and provide a baseline for our future work on sea turtle foraging behavior and resource use in an understudied region of the Caribbean.

UNDERSTANDING PATTERNS OF SMALL-SCALE MOVEMENTS IN LOGGERHEAD TURTLES NESTING AT THE CABO VERDE ARCHIPELAGO

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Behavioural ecology is an essential part of conservation science. This is because individuals will choose specific habitats for specific behaviours, yet this "habitat-behaviour match" remains poorly characterized, particularly for marine species. Spatiotemporal information in terms of distribution and abundance is essential in the management of migratory species. While satellite telemetry has helped to describe long-distance animal migrations, there is still a need to describe small-scale movements and particular in the habitat use of protected areas. This is especially true for sea turtles, who may optimize temperature exposure as well as local feeding at their nesting sites. Fine scale distribution data in Cabo Verde's water is almost non-existent, despite having an important network of protected areas. To filling this gap, we deployed 15 novel, low-cost, GSM (Global System for Mobile communication) trackers on nesting loggerhead females (*Caretta caretta*) in 2021 sand 14 tags in 2022 located during nesting in Boa Vista Island. We show in this large aggregation, there are two types of behavior between nesting events: exploration of habitats within the first km of the coast and a more oceanic foray, swimming for up to 250 km between nesting events. Importantly, regardless of where the turtles were tagged, the vast majority visited the Southeast coast of Boa Vista Island, probably because of the environmental conditions, in front of main nesting beaches of the island. For the conservation and management of protected areas, it is important to identify the link between nesting and shelter areas. Describing the spatial ecology of animal movements contributes to understanding the overall network of habitat use and the need for connectivity.

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*COMBINING SATELLITE AND ACOUSTIC TELEMETRY ENABLES ANALYSIS OF POST-NESTING MOVEMENT PATTERNS FOR NORTHWEST ATLANTIC OCEAN LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*)

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Few studies combine satellite and acoustic tagging to monitor sea turtle movement patterns and habitat use. Both approaches can be applied synergistically to describe behaviors and characterize habitats. Taken together, each form of telemetry can mitigate limitations associated with the other form. Although acoustic detections are highly variable and dependent on the presence of an animal in range of an acoustic receiver, acoustic transmitters are cost-effective and often have a significantly longer battery life than satellite transmitters. In addition, acoustic receivers can be situated in a variety of ways within a study site, such as moored to the sea floor or placed on sail drones or vessels using hydrophones to actively track individuals. Conversely, satellite detections are nearly continuous regardless of location, but satellite transmitters are expensive, as are concomitant satellite data acquisition fees. Northwestern Atlantic Ocean (NWA) leatherback sea turtles (*Dermochelys* coriacea) present a unique opportunity to use both telemetry methods to analyze their post-nesting movement patterns and high-use habitats, as they occupy foraging habitats near acoustic receiver arrays situated along the eastern seaboard of North America and in the northern Gulf of Mexico. Eleven adult female leatherbacks were double-tagged with Vemco V16 (Innovasea Systems Inc.) acoustic and SPLASH-10 (Wildlife Computers, Inc.) satellite transmitters at Pacuare Nature Reserve, Costa Rica (*N*=6) and Juno Beach, Florida, USA (*N*=5) during 2019–2022. At Juno Beach, five nesting leatherbacks were only tagged with acoustic transmitters during 2021, and ten were tagged with satellite transmitters during 2022. Raw Argos data were analyzed using a Baysian space-state model to distinguish between traveling and area restrictive search (i.e., foraging or inter-nesting) behavioral states. Satellite data revealed post-nesting movements for four leatherbacks tagged at Pacuare (mean duration: 140 days); however, one tag stopped transmitting after 47 days. Two turtles were tracked to foraging grounds in the

northeastern Gulf of Mexico, and one was tracked to the Mid-Atlantic Bight, but did not display foraging behavior before transmissions ceased 143 days after deployment. Three acoustic receiver arrays detected Pacuare leatherbacks in the northeastern Gulf of Mexico (*N*=2) and Scotian Shelf (*N*=1), with detections occurring up to 2.5 years after tag deployment. Satellite transmitters have tracked three leatherbacks from Juno Beach to the Mid-Atlantic Bight (*N*=2) and Scotian Shelf (*N*=1), and tags are still transmitting as of November 10, 2022 (155 days). Eleven acoustic receiver arrays detected eight Juno Beach leatherbacks from the southeast Florida Shelf to the Mid-Atlantic Bight, with detections occurring up to one year after deployment. Project results indicate that acoustic receivers continue detecting tagged turtles when satellite tags have stopped transmitting, and are able to identify when leatherbacks occupy foraging grounds. These biotelemetry data will be used to describe environmental conditions at current high-use leatherback habitats and will be overlaid with fishery and boating activities to identify potential high-risk areas. Future research, including deployment of more acoustic transmitters and expanding the spatial coverage of acoustic receivers, is needed to maximize the potential of acoustic telemetry as a reliable method for long-distance movement studies.

*IN-WATER METHODOLOGY FOR ASSESSMENT OF FEEDING HAWKSBILLS IN GORGONA NATIONAL PARK, COLOMBIAN PACIFIC

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CIMAD, Colombi

The hawksbill sea turtle (*Eretmochelys imbricata*) is critically endangered worldwide. No nesting beaches have been reported for the Colombian Pacific, and the populations studied have been juveniles in feeding areas, as in the Gorgona National Natural Park case. On this near-shore island, local researchers and environmental authorities have monitored green turtles (*Chelonia mydas*) and hawksbill turtles since 2004. In 2020, Cañas et al. reported 89 captures of 49 individuals of hawksbill turtles between 2004 and 2018. For the present study, we reported 33 captures of 22 individuals in one monitoring year (July 2021-June 2022). Our one-year results are equivalent to 45% of recruits registered by Cañas and collaborators in 2020 during 14 years. The methodology we implemented in this study was based solely on the manual capture of hawksbill turtles. To obtain a more significant number of catches, we concentrated on the sectors of the rear reef close to the beaches of the two most extensive reefs of Gorgona (La Azufrada and Playa Blanca). The search focused on the edges of reef patches and the small holes hawksbills use to rest at night. 79% of the captures rested on these structures. Although the present study focused only on hawksbills, our results demonstrate that with concentrated effort and personnel trained in hawksbill hand-capturing tailored for Gorgona, the estimation of the recruit population of one of the significant Pacific hawksbill populations can be higher than that reported by Cañas et al. (2020).

*LOGGERHEAD SEA TURTLES SHOW BEHAVIORAL PLASTICITY WHEN USING NERITIC FORAGING AREAS: THE CASE IN THE ADRIATIC SEA FROM 37 YEAR OF CAPTURE-MARK-RECAPTURE

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Assessing sea turtle movements and connectivity among different areas is pivotal to understand their biology and implement efficient conservation actions. Capture-Mark-Recapture (CMR) records of 294 loggerhead sea turtles (*Caretta caretta*) were collected in the period 1984-2021 in the Adriatic Sea, one of the most important neritic foraging areas for this species in the Mediterranean, for a total of 311 release/re-encounter pairs. The release events happened between 1984 and 2019 (median year: 2014, IQR = 6; n = 311). The main observed pattern was fidelity to Adriatic, indicated by a significantly shorter CMR distance (distance at sea between release and re-encounter sites) than the potential dispersal distance (distance estimated from satellite tracking data). Moreover, turtles showed fidelity to specific Adriatic subareas (N = North, S = South), indicated by a significantly higher proportion of re-encounters in the same area of release (NN = 17, SS = 59) compared to re-encounters in a different area (NS = 17, SN = 5). No seasonal pattern was detected in the movements of the turtles between subareas and significantly shorter distances were observed in turtles released and re-encountered in the cold season, indicating shorter movements in this period. Part of the turtles left the Adriatic going anywhere in the Mediterranean basin. Among these, a strong connectivity with nesting sites in Greece was observed, confirming with empirical evidence that this is the most important breeding area for turtles foraging in the Adriatic Sea. The findings of this study can represent a general behavioral pattern of the species in neritic foraging grounds and show the value of complementing studies on movements from nesting sites with those from foraging grounds.

CLUSTERING AND CLASSIFICATION OF VERTICAL MOVEMENT PROFILES FOR ECOLOGICAL INFERENCE OF BEHAVIOR

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Vertical movements can expose individuals to rapid changes in physical and trophic environments- for aquatic fauna, dive profiles from biotelemetry data can be used to quantify and categorize vertical movements. Inferences on classes of vertical movement profiles typically rely on subjective summaries of parameters or statistical clustering techniques that utilize Euclidean matching of vertical movement profiles with vertical observation points. These approaches are prone to subjectivity, error, and bias. We used machine learning approaches on a large dataset of vertical time series (N=28,217 dives) for 31 post-nesting leatherback turtles (*Dermochelys coriacea*). We applied dynamic time warp (DTW) clustering to group vertical movement (dive) time series by their metrics (depth and duration) into an optimal number of clusters. We then identified environmental covariates associated with each cluster using a generalized additive mixed effects model (GAMM). A convolutional neural network (CNN) model, trained on standard dive shape types from the literature, was used to classify dives within each DTW cluster by their shape. Two clusters were identified with the DTW approach- these varied in their spatial and temporal distributions, with dependence on environmental covariates, sea surface temperature, bathymetry, and time-lagged sea surface height deviation and surface chlorophyll-a concentrations. CNN classification accuracy of the five standard dive profiles was 95%. Subsequent analyses revealed that the two clusters differed in their composition of standard dive shapes, with each cluster dominated by shapes indicative of distinct behaviors (pelagic foraging and exploration, respectively). The use of these two machine learning approaches allowed for discrete behaviors to be identified from vertical time series data, first by clustering vertical movements by their movement metrics (DTW) and second, by classifying dive profiles within each cluster by their shapes (CNN). Statistical inference for the identified clusters found distinct relationships with environmental covariates, supporting hypotheses of vertical niche switching and vertically structured foraging behavior. This approach could be similarly applied to the time series of other animals utilizing the vertical dimension in their movements, including aerial, arboreal, and other aquatic species, to efficiently identify different movement behaviors and inform habitat models.

SEA TURTLES IN THE BAHÍA MÁLAGA CONSERVATION MOSAIC, COLOMBIAN PACIFIC

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The species and sizes of sea turtles present in the Bahía Málaga Conservation Mosaic, Valle del Cauca, were characterized between 2016-2020 through aquatic monitoring and voluntary delivery by native fishermen. The registry of individuals was determined by aquatic monitoring, which was divided into three phases: exploratory sampling, continuous sampling, standardized sampling, plus voluntary deliveries by fishermen in their fishing tasks. A total of 107 hours of effort were used to detect 51 individuals of hawksbill (*Eretmochelys imbricata*) and black (*Chelonia mydas*) turtles. These results contribute as a baseline for the knowledge of sea turtles as an effective strategy for research and conservation in Bahía Málaga.

ACROSS THE GREATER CARIBBEAN: MOVEMENTS OF SEA TURTLES FROM PROCTMM HEAD STARTING AND REHABILITATION PROCESS

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The implementation of sea turtle conservation strategies such head starting focused on increasing the probability of survival in the first stages of life in the natural environment, and rehabilitation processes of wild individuals seeking to return turtles in ideal health conditions, require follow-up procedures after their introduction. ProCTMM uses methods such as tagging with plastic tags and satellite tagging in some of them that allowing to record their movements, obtaining 13 reports through plastic tags and 8 turtles with satellite tag. Eight of 13 reports obtained have been international: 3 Haiti (Port Salute (2) and Costas de Arachaie), 2 in the United States (Pensacola and the Florida Keys), 2 in Cuba (Zapata National Park and Ceiba Hueca Town) and 1 in Nicaragua; In order to estimate their movement to the report location, we use the routes made by oceanographic drift buoys in the Greater Caribbean. The individuals with satellite tags evidenced two paths, the juveniles from the head starting described movements in a Northwest direction moving along the Caribbean, while those from rehabilitation (adults) took more coastal routes in an East direction. When superimposing images with the paths of oceanographic drift buoys with the paths of the

specimens followed by satellite, it was possible to observe that sections of the routes described coincide with the direction of some of the main Caribbean currents. With the results obtained, it can be evidenced that the directions of the movements described by each specimen could be related to the stage of the life cycle, detecting a random behavior in the juveniles, which could respond to a more exploratory phase using the marine currents moving in favor, against or leaving them according to their own requirements.

COMPARING AND CONTRASTING MOVEMENT BEHAVIORS OF JUVENILE GREEN (*CHELONIA MYDAS)* AND HAWKSBILL (*ERETMOCHELYS IMBRICATA*) SEA TURTLES USING HIDDEN MARKOV MODELLING OF FINE-SCALE POSITIONING ACOUSTIC RECEIVER ARRAY DATA IN THE US VIRGIN ISLANDS

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Tracking the movement of animals can provide valuable information on how they utilize their environment and help inform conservation measures. Acoustic telemetry is a powerful and commonly used tool for tracking animals but can be limited by low resolution position estimates in its traditional applications. The use of fine-scale positioning system (FPS) acoustic receiver arrays can overcome some of these limitations and provide high resolution movement data for tagged animals across long time periods (months to years). We are currently using an FPS array to track juvenile green sea turtles (*Chelonia mydas*) and juvenile hawksbill sea turtles (*Eretmochelys imbricata*) in Brewers Bay, St. Thomas US Virgin Islands. Using a hidden Markov model approach, we are characterizing the movement behaviors of the two species. We found that green sea turtles have high site fidelity to foraging and resting areas, and their movements can be characterized chiefly by foraging/resting behaviors and transiting behaviors where they travel between foraging and resting sites. Hawksbill sea turtles tend to show more variable space use and appear to display roving foraging behavior rather than persistently foraging in the same isolated sites. As we gather a longer time series of movement data, we will investigate how these patterns vary seasonally and under different environmental conditions. However, the differences in behaviors that we are already recording have implications for the conservation of these species, highlighting the need to consider the individual needs of each species when developing sea turtle conservation measures.

IDENTIFYING SPACE USE AND FORAGING PATTERNS OF JUVENILE GREEN SEA TURTLES (*CHELONIA MYDAS*) IN A HALOPHILA STIPULACEA-DOMINATED BAY USING A FINE SCALE POSITIONING ACOUSTIC ARRAY

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As green sea turtle (*Chelonia mydas*) populations in the Caribbean recover from historical overexploitation, growing environmental obstacles pose threats to the recovery of this species. The invasion of *Halophila stipulacea* seagrass in previously Halodule wrightii and *Syringodium filiforme* -dominated beds drastically alters the composition of the turtles' foraging habitat, with unknown effects on this threatened species. This change in forage supply for juvenile and adult green turtles in the Caribbean could impact their future habitat use and resource partitioning. We are conducting a fine-scale tracking study of green turtles' space use patterns in Brewers Bay, St. Thomas, US Virgin Islands to understand if and how their movement and foraging behavior is altered by the *H. stipulacea* invasion to better inform conservation and management agencies. We deployed a fine-scale positioning system (FPS) acoustic receiver array of 59 VR2W and VR2TX receivers to cover ~1.5 km^2 of Brewers Bay and Hawksbill Cove, including seagrass, coral reef, and sand/rock benthic habitat. We tracked 17 individual juvenile green turtles with V16P acoustic transmitters with an estimated precision of ± 2 meters. Using preliminary analysis of the first 6 months of tracking data, we generated a grid of 150 regularly spaced points (~26 m apart) to sample the seagrass composition in the highest trafficked foraging areas. We are using this data to create a benthic distribution map of the native and invasive seagrass composition to pair with the turtles' daytime foraging locations. Initial results show that most turtles display typical diel patterns of movement with higher activity levels in shallow mixed-seagrass habitat during the day and lower activity levels in coral and rocky reef habitats at night. All turtles exhibited high site fidelity to their foraging locations as well as their resting locations. We will link these movement results to changes in seagrass composition within our sampling grid using resource selection functions to estimate the probability of this keystone species foraging in native or invasive seagrass beds.

*WHERE DO EASTERN PACIFIC LEATHERBACK TURTLES DISPERSE DURING THEIR PELAGIC JUVENILE PHASE?

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Satellite tracking data reveals that adults from the critically endangered Eastern Pacific (EP) leatherback (*Dermochelys coriacea*) subpopulation perform surprising migrations from index nesting beaches in Mexico and Costa-Rica. Nearly all tracked individuals first move southwards, crossing the equator near the Galapagos archipelago and then dispersing south to forage off the coast of Peru and Chile. Based on the Learned Migration Goal (LMG) hypothesis, it is expected that this migratory behavior is inherited during juvenile life history stages. Consequently, one would expect that juveniles from the EP leatherback subpopulation would also disperse into the Southeast Pacific Ocean. In accordance with oceanography, a non-negligible part of the EP leatherback subpopulation should disperse within the North Pacific (NP), however, no observations exist (satellite tracking, conventional tracking, genetics data) to substantiate this premise. Existing studies have demonstrated that the dispersal of juvenile sea turtles is primarily governed by oceanic currents. Basic knowledge of Northeast Pacific Ocean circulation indicates that currents off the

coast of Costa-Rica and Panama are generally flowing northwestwards, rarely southwards! This is further confirmed by the trajectories of satellite-tracked surface drifters. During the last three decades, over 95% of the surface drifters passing within 20° of longitude west of the coast of Mexico and Costa-Rica dispersed into the North Pacific Ocean. In this study we use the Sea Turtle Active Movement Model (STAMM), an Individual-Based Model (IBM) to simulate hatchling dispersal under the effect of oceanic currents and habitat-driven movements. We investigate the apparent inconsistency between expected dispersal patterns of juvenile EP leatherback turtles and observed adult migrations. We investigate how different swimming behaviors can influence dispersal and potentially explain observed adult migrations. Our examination of both surface and subsurface dispersal patterns suggests that circulation at depth could lead to higher densities of individuals from the EP subpopulation in the SP, as southern crossings may be less dependent on specific currents and more connected to the presence of tropical cells. Our results also reveal that southern crossings are not highly correlated with swimming activity, which does not impact the NP-SP distribution but rather moves individuals away from the center of gyres towards favorable habitats, where elevated levels of micronekton may serve as a better proxy for food abundance than net primary production.

PERFORMANCE ANALYSIS FROM SATELLITE TRACKING OF JUVENILE SEA TURTLE WITH PROTOTYPE MICRO-SATELLITE TAGS

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After hatching, sea turtles disappear into the ocean until their return to nest at natal beaches or occupy adjacent waters many years later. Within the sea turtle community, this period is commonly referred to as the “Lost Years”. Heretofore, the small sizes and prolonged dispersal phases of juveniles have posed many challenges for the development of satellite tracking studies. However, recent developments in tag miniaturization technologies and data compression algorithms have facilitated advances that have enabled researchers to undertake groundbreaking studies on the movements and dispersal of early-stage turtles. Among other advances, new tags are now equipped with solar cells and pressure sensors, extending the tag lifetimes while providing first-ever dive data for extended movements (> 3 days) of small (~ <125 g) early-stage turtles. Here we summarize preliminary findings about the performance of prototype microsatellite tags (manufactured by Lotek Wireless, Inc.) deployed over a nearly three-year period on 154 juvenile sea turtles from 4 species (leatherback, loggerhead, Kemp’s ridley, green) and released from 4 different locations in the North Atlantic Ocean. We provide an overview of results from the 3 years of juvenile satellite-tracking experiments with an emphasis on examining tag performance, including metrics to investigate transmission success (transmission characteristics, tracking duration) and evaluations regarding the causes of tag failure. We also consider the influences of turtle morphology and behavior within our analyses. Our results reveal that despite unfavorable transmission features (low transmission power and transmission/reception ratio), transmission performances were satisfactory and enhanced by specifically tailored transmission strategies. However, tracking durations were abnormally brief, and did not allow for a correct trajectory analysis. In many cases, battery exhaustion and bio-fouling could be quickly ruled out as causes for truncated tracking durations although a small percentage of early failures could be attributed to readily explicable causes, including predation or antenna breakage and tag shedding against rocks. A non-negligible percentage of failures remains unexplained by the aforementioned causes. Our studies also suggested that tracking durations appear to be correlated with tracked species (e.g. shorter tracking durations from leatherbacks than from loggerheads) or tracked individual size/mass (e.g. large green turtles are more prone to shedding or damaging tags than smaller ones) suggesting that the diving behavior of juveniles can be too strenuous for these fragile miniaturized tags. We hope that our findings will help to inform the sea turtle biologging community about the promise and potential of recent technological advances for addressing novel questions about sea turtle biology and life history and will catalyze more interest and attention to the relevance of this work for sea turtle management and conservation.

DAYTIME ACTIVITY PATTERNS OF GREEN SEA TURTLES IN THE GALÁPAGOS ISLANDS

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Further quantification of green sea turtle (*Chelonia mydas*) dive behaviors can give insight into conservation research for both ecosystem management and anthropogenic activities. Between 2016 and 2021, using simultaneous video, Global Positioning System (GPS), and time depth recorders, we measured the daily fine-scale activity patterns of 14 green turtles in the Galápagos Islands Bioregions. Our activities include dive duration, dive profiles, spatial ecology, and underwater activities such as foraging, resting, and interaction with other species, allowing us to better understand the behavior, ecology, and spatial movements of marine turtles, which is crucial for their protection and conservation. For the locations where the turtles were collected, ocean temperatures ranged from 16 *C to 21 *C. Of the 14 individuals, 7 spent most of their time diving along the ocean floor, 6 spent most of their time swimming in the dive column, and 1 spent most of their time swimming just below the surface. The proportional ranges for the time spent for any given turtle evened out with an average of 38.4% and 33.2% of time spent diving along the ocean floor and diving within the water column, respectively. This gives support that both the ocean floor and the dive column are important areas for *C. mydas* conservation measures. Data demonstrated that 13 out of 14 turtles ate, with algae being the most popular consumption. A total of 8 out of 13 turtles solely consumed

algae, 3 turtles consumed both algae and cnidarians, while 2 out of 13 turtles solely consumed cnidarians. Interestingly, 3 of the 5 islands showed a correlation between feeding behavior and capture location. Each of the turtles captured near Isabela consumed both algae and cnidarians, while the turtles captured near Floreana and Espanola consumed only algae. The diversity of diet and behavior of *C. mydas* in the Galápagos Islands demonstrates that whole ecosystem protections are necessary for sea turtle conservation. Further studies in other locations could give relevant comparative data for building a continued understanding of sea turtle activity patterns.

THE MALE EAST-PACIFIC GREEN TURTLE THAT EATS FISH

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Green sea turtles are known for, and named after, their ontogenetic shift that occurs as the turtles transition from the juvenile pelagic foraging phase to the coastal foraging phase. A major exception is green turtles that nest and forage in the eastern Pacific Ocean; here, coastal juveniles and adults consume an omnivorous diet of seagrasses, algae, mobile and sessile invertebrates, among various nonfood items. Our report documents a male East-Pacific green turtle (CM-31) opportunistically foraging on fish parts cast overboard during processing, which has implications for future sea turtle diet studies. From CM-31 we collected a whole blood sample (< 1 ml/kg) from the cervical sinus, and an epidermal (1 cm^2) sample from the trailing edge of one of the hind flippers. Turtle CM-31 had skin $\delta^{15}N$ and $\delta^{13}C$ ratios ($\delta^{15}N$ = 17.66‰, $\delta^{13}C$ = −14.34‰) that were higher compared to whole blood $\delta^{15}N$ and $\delta^{13}C$ ratios ($\delta^{15}N$ = 16.49 ‰, $\delta^{13}C$ = −15.07 ‰). At 93 cm curved carapace length, we assumed CM-31 was not growing rapidly and was instead approaching, or already in, the adult reproductive years. As such, we posit that skin stable isotope ratio reflects the cumulative diet across previous years he was foraging along the coast, while the whole blood stable isotope ratio reflects food consumed in the ~6 months prior to September 2017. Turtle CM-31 had $\delta^{15}N$ ratios that were higher than the 46 East Pacific green turtles sampled as part of our forging and diet study conducted in two bays adjacent to where we captured CM-31. It is probable that CM-31 is a member of this population but is displaying an individualist foraging strategy not indicative of other turtles in the population. This highlights the need for consideration of human-wildlife interactions, ingestion of non-natural foods, and individual variability in sea turtle foraging that may cause inaccuracies in isotopic modeling. This turtle's behavior also points to potential risks associated with sea turtle acclimation to fishing activities and attraction to fishing vessels that may increase risk of injury or mortality.

UNRAVELING THE MIGRATORY MYSTERIES OF NORTH PACIFIC LOGGERHEADS USING EXPERIMENTAL OCEANOGRAPHY

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North Pacific loggerhead sea turtles (*Caretta caretta*) undergo one of the greatest of all animal migrations, entering the sea as hatchlings in Japan and re-emerging years later along important foraging grounds in the Eastern North Pacific (Briscoe et al. 2021). Yet the mechanisms that connect these distant habitats have remained poorly understood. Aggregations of juvenile loggerheads were long known to feed along the Pacific coast of Baja California, Mexico. But until recently, scientists had no clear understanding of the specific mechanisms by which Japanese loggerheads migrate across the entire North Pacific Ocean to the bays of Baja California. Our research group recently analyzed 15 years of data from satellite tagged juvenile loggerheads released in the Western and Central North Pacific. An outcome of this work was a new hypothesis—the "thermal corridor" hypothesis (TCH, Briscoe et al. 2021)—which we propose to test by experimentally deploying cohorts of satellite-tagged loggerheads in the Eastern North Pacific across four years of variable environmental conditions. The TCH proposes that loggerheads at the east end of the CNP convergence zone can access the west coast of North America only under anonymously warm conditions (3-month running mean of SST anomalies ≥ 0.5 deg C). Under cool conditions (3-month running mean of SST anomalies ≤ -0.5 deg C), we hypothesize that loggerhead juveniles will turn back to the west. We propose to test this hypothesis by deploying cohorts of satellite-tagged loggerheads in the Eastern North Pacific. We propose an "experimental oceanography" approach—by releasing experimental cohorts of 25 juvenile loggerheads per year over four years, we will be able to provide a novel field-test of the TCH. In addition, the release of 100 turtles (25 per year over 4 years) in the east end of the CNP convergence zone will also set the stage for us to understand what drives changes in these migratory pathways under climate variability and directional climate change. These new data will allow a full exploration of loggerhead movements in the Eastern North Pacific, setting the stage for predictive species distribution models.

HABITAT USE AND MIGRATORY MOVEMENTS OF THE LEATHERBACK TURTLE (*DERMOCHELYS CORIACEA*) IN THE EASTERN PACIFIC OCEAN

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There is currently little information on the distribution, feeding/breeding zones and migratory routes of the leatherback turtle, *Dermochelys coriacea*. This situation represents a problem for conservation, due to the high costs involved in spatial-temporal monitoring of the species. In an attempt to resolve this situation, a species distribution model (SDM) is proposed, an approach that is commonly used to identify potential areas of distribution of various terrestrial and marine species. The objective of this study is to construct a numerical model that relates data on the presence of the leatherback turtle in the Eastern Pacific Ocean (EPO) with different environmental variables, in order to define the ideal habitat for the species. Spatially, the work covers the area from 25°S to 35° N, from the coastline of the American continent to ~145°W in the open ocean. The model was constructed using information from a database containing 1445 records of the presence of *D. coriacea* in the EPO from the 2003-2015 period. The average conditions of the same period (2003-2015) of sea surface temperature (SST), surface concentration of chlorophyll-a (CHL-a), sea level anomalies (SLA) and distance to oceanic islands were used. The model is based on the maximum-entropy algorithm (MaxEnt), which uses only presence data as input. Preliminary results suggest that the MaxEnt approximation is a useful tool for modeling the occurrences of this species with an approximate ~75% precision rate. SST is presumably the variable that most influences the distribution of this species. Once the final model is constructed, it will be used to simulate likely distribution areas based on average monthly environmental conditions, and generate seasonal maps of potential leatherback habitat in the EPO.

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*INFERRING HABITAT USE AND FORAGING ECOLOGY DURING SEA TURTLE "LOST YEARS" USING STABLE ISOTOPE ANALYSIS

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Understanding habitat use and foraging ecology for oceanic dispersal-stage juvenile sea turtles is important for the conservation of sea turtle species across life-stages. In the Gulf of Mexico multiple sea turtle species inhabit Sargassum lines during this early life-stage, yet the foraging ecology of these young turtles is not well understood. To better understand habitat use and infer foraging ecology for oceanic dispersal-stage green (*Chelonia mydas*, n=77), Kemp's ridley (*Lepidochelys kempii*, n=22), hawksbill (*Eretmochelys imbricata*, n=4), and loggerhead (*Caretta caretta,* n=2) turtles captured offshore in Northern and Eastern Gulf of Mexico between 2013 and 2022, we used bulk carbon and nitrogen stable isotope analysis of skin samples and potential prey items collected from Sargassum habitat associated with captured turtles. Potential prey items included shrimp, crabs, bivalves, and Sargassum spp. Model selection framework was used to evaluate the relative importance of turtle size, sampling year, and sampling location to isotope signatures. The MixSIAR package in R was used to infer the proportion of diet consisting of the sampled prey items. We found that turtle carbon and nitrogen signatures did not significantly differ between sampling locations but bulk nitrogen did differ between species and by turtle size, indicating a species-based and size-based prey selection. This was supported by the MixSIAR model which showed an increase in fish (or similar trophic level) consumption with increasing turtle size and a larger proportion of fish consumed by Kemp's ridley turtles compared to green turtles. Overall, invertebrates made up the largest proportion of sea turtle diet (>75%) and Sargassum the least (<5%). All prey items had similar carbon signatures but differed in nitrogen signatures based on a consumer vs. primary producer split. Overall, isotopic signatures of turtle species and potential prey items provide insight into the foraging ecology of these species during their early "lost years". Understanding diet and habitat use at this life stage is important for filling knowledge gaps of sea turtle life histories and creating comprehensive management plans to protect these species.

URBAN TURTLES: IN-WATER SURVEYS OF SEA TURTLES AT NEAR-BY URBANIZED COASTAL AREAS

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Hawksbill turtles continue to be classified as critically endangered species by IUCN and in many countries, while green turtles are classified as threatened, despite the reduction of threats such as poaching, international trade, and urban development. In Puerto Rico, hawksbills and green turtles have been protected since 1978 by Federal Law (US Endangered Species Act) and in 1986 by State Law (Ley de Vida Silvestre). Sea turtle nesting surveys to determine status have been conducted since 1984. In addition to nesting surveys, in-water surveys to study sea turtle aggregations at feeding grounds and developmental habitats were conducted since 1992. Most of the in-water surveys were conducted on isolated, pristine adjacent islands of Puerto Rico (i.e. Mona, Monito, Culebra Archipelago, and Desecheo Islands). Recent in-water surveys identified other important juvenile/sub-adult feeding aggregations along mainland Puerto Rico. These sites are Tres Palmas (Rincón), Rompeolas (Vieques); Pt Salinas (Toa Baja), Escambrón (San Juan) and Reserva Marina de Isla Verde (Carolina). Two of these sites (Rincón and Isla Verde) are protected as marine reserves. All of these sites are affected due to their proximity to high-density housing, condos, hotels, or other man-made infrastructure (such as piers). In-water surveys were conducted at all "urban" study sites to determine sea turtle composition, structure, health, and other biological parameters. The catch per unit of effort for each site was 1.8 turtles/hr (Isla Verde); 5.4 turtles/hr (Rompeolas); 5.0 turtles/hr (Pt Salinas); 2.8 turtles/hr (Tres Palmas); and 3.4 turtles/hr (Escambrón). Ninety percent of the captured and observed turtles at Isla Verde, Rompeolas, and Tres Palmas were juvenile hawksbills with a size range of 24.1 cm to 61.0 cm OCCL. At Escambrón and Pt Salinas, 100% of turtles caught and observed were juvenile green turtles (size range: 23.3- 60.0 cm CCL). Recapture rates, home range, and other population dynamics parameters are similar to other "pristine" feeding grounds. However, differences in size class structure between areas were found. Despite the proximity of urban areas and all its implication for detrimental factors to habitats, these areas can be considered important feeding and developmental habitats providing food and shelter to these aggregations. Future studies should include habitat characterization, home range, and migratory patterns to determine possible expansions of the marine reserves. Also, management actions should be taken to improve habitat quality and further threat reduction.

IN-WATER OBSERVATIONS OF CAPTIVE-RAISED JUVENILE HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*) UPON RELEASE INTO THE OCEAN

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Head start programs have been developed to increase the number of turtles that reach later stages of development. However, there are concerns associated with these programs, including the potential for altered behavioural traits leading to decreased survivability. In this study, 11 hawksbill turtles (*Eretmochelys imbricata*) were raised in a purpose-built research facility for approximately 2 years before being released into the Great Barrier Reef (Australia). Each turtle was released individually and recorded by two scuba divers and one snorkeller for up to 25 minutes. Behaviours were later described from the videos, categorised, and analysed. All 11 turtles were able to dive and swim, with good buoyancy control, immediately upon release. Total in-water observation time was 123.6 minutes, with mean observation per turtle of 11.2 ± 3.6 minutes (0.5-25.0). However, six turtles swam out of view within 3 minutes and five

were observed for more than 20 minutes each. Nine behaviours were recorded, of which combined locomotive behaviours (moderate swimming, relaxed swimming, and "hawksbill walk" [crawling]) were the most prominent (55.7% total observation time). Swim time of the captive-raised hawksbills was comparable to published studies that observed wild turtles (33.4%-78.9%). The turtles in this study also spent time surfacing to breathe (14.0%), resting on the benthos (13.5%), and grooming (11.3%). Each of these behaviours were also present in published studies of wild turtles. Feeding was the only behaviour not observed in these study turtles that was present in wild turtle studies, likely because they were fed 48 hours prior to release. Dive profiles of the turtles were also found to be comparable with published data from wild hawksbill studies for average depth (4.8 ± 0.4 m, n=11 turtles) and dive time (9.1 ± 1.6 minutes, n=5 turtles). During observation, six turtles had one dive (<3 minutes), four turtles had two dives, and one turtle had three dives. Ten turtles reached the benthos during observation; the turtles observed for more than 20 minutes spent most of their time on the benthos (74.5%, range 12.0-22.1 minutes), whereas the turtles observed for less than 3 minutes spent most of that time in the water column (59.0%, range 0.3-1.1 minutes). Turtles' interactions with in-water observers were recorded as ignoring divers (15.8%); escaping away from the divers (11.0%); aware of the divers – intermittently looking at divers (53.2%); and focused on the divers – constantly looking at divers (20.1%). These results indicate that the captive-raised turtles maintained their innate ability to navigate depth, diving and breath taking, despite being reared in a relatively constricted environment. The turtles also displayed behaviours key to survival in the wild, including evasive manoeuvres and escape, resting, and investigating, which were comparable with wild hawksbill observations published in the literature. Thus, this case study of captive-reared hawksbill turtles showed that in-water observations of turtles on first release into the ocean is a viable early indicator of survivability. Adoption of detailed behavioural descriptions in future studies would facilitate better comparisons between other head-started cohorts and their wild-raised counterparts.

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*SPATIAL DENSITY MODELS FOR FOUR SPECIES OF SEA TURTLE ON THE EAST COAST OF THE UNITED STATES

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Spatially explicit estimates of distribution and abundance of a species are required to quantify potential impacts from human activities such as military training and testing, offshore energy development, and fisheries. On the east coast of the United States, four species of sea turtle can commonly be found (loggerhead, green, Kemp's ridley, and leatherback turtles) and require management under United States law. Line transect surveys from seven different survey organizations, including both aerial and shipboard platforms, were collated for the study area, which extended from Florida to Maine and out to the border of the United States Exclusive Economic Zone. More than 1.2 million linear kilometers of survey effort was included, spanning 2003-2019. Density spatial models for the four species were generated by fitting detection functions to survey observations, estimating density for segments of surveys, then fitting generalized additive models relating species' density to environmental covariates. Almost a third of available sightings were unidentified turtles, assumed to be hardshell species given leatherbacks' distinct appearance and coloration. Not including these sightings would appreciably underestimate density for hardshell species so a conditional random forest model was used to assign unidentified hardshell sightings to species. Density estimates were adjusted for availability bias, the proportion of time animals spent diving and were unavailable to be detected by observers, using dive data from the region or nearby regions. Dive data from animals released within the study area was used for loggerhead and leatherback turtles availaiblity bias estimates. Gulf of Mexico dive data were used for green and Kemp's ridley turtles, the closest region

where appropriate dive data were collected. Hardshell turtles were predicted to be further south in cool months, moving northwards in late spring and early summer to occupy seasonal nearshore habitats. Leatherback turtles were predicted in high densities off Florida year-round, as well as off the continental shelf and in the Gulf of Maine, which has been confirmed via satellite tracking. These are the first sea turtle spatial density models for the region produced in the last ten years and the first to classify unidentified sightings to the species level, providing an updated, critical tool to managers responsible for the conservation of these species. Conservation actions that could be supported by these models include mitgation for shipping, naval exercises, and offshore energy developments by avoiding areas of high density, siting of marine sanctuaries or critical habitat designations, and estimating take from human activities. The models also provide ecological insights into the distribution and preferred habitat of the species. At-sea abundance and uncertainty estimates are provided for all four species and account for all but the smallest size classes of animals, providing an important complement to counts of nesting females and population estimates derived from demographic models.

*PRELIMINARY OBSERVATIONS ON IMPLANTATION AND EFFICACY OF INTERNAL ACOUSTIC TAGS IN LOGGERHEAD SEA TURTLES (*CARETTA CARETTA*) AND EXTERNAL ACOUSTIC TAGS IN LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*)

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Acoustic tags can reveal the location of aquatic animals for long periods of time, with some tags having battery life of up to ten years. Acoustic tags have been attached to the shell of some aquatic turtle species, but premature detachment has been problematic. In other taxa, surgical implantation of acoustic tags has been successful, with long periods of tag detection. In this study, we used passive acoustic telemetry to investigate post-release outcomes of stranded, disentangled, or rehabilitated sea turtles released off Massachusetts, USA, using both internal and external tagging methods. We surgically implanted acoustic tag models V13-1H and V16-4H (Innovasea Systems Inc., Bedford, Nova Scotia, Canada) subcutaneously in the pre-femoral space of fifteen subadult loggerhead sea turtles that had been rehabilitated after cold-stunning in Massachusetts, USA. Tags were implanted in June, 2021 (n=4), and between March and May, 2022 (n=11). Under general and local anesthesia, a scalpel incision was made, followed by blunt dissection, tag insertion, and two-layer closure. Turtles were monitored for a minimum of eight weeks, post-surgery. Incision healing was complete within six to twelve weeks in 12 out of 15 turtles (80%). Three turtles had incisions that did not heal well initially, and required repair four to eight weeks after the initial surgery. Healing for two of those turtles occurred four and twelve weeks after repair. The third turtle did not heal well, and we opted to remove the tag three weeks later to expedite the turtle's release. After tag removal, the incision healed well as an open wound after eight weeks. We were able to detect 14 out of 15 tags in a captive setting using a hydrophone. Tagged loggerheads were released in August, 2021 (n=4) and between June and September, 2022 (n=10). We've had 781 detections of eleven loggerheads from 26 different receivers off the coasts of Massachusetts, Rhode Island, New York, North Carolina, and offshore in southern New England waters. We deployed external acoustic tags on eight leatherback turtles after disentanglement from fishing gear (n=7) or stranding on shore (n=1). Tagging took place over three years, from July, 2019 to July, 2022, and included adult males, adult females, and subadults. Under local anesthesia, acoustic tag models V16-4H were attached through two osteotomy sites on the lateral ventral pygal region of the carapace. One turtle died from subsequent entanglement shortly after release; of the remaining seven leatherbacks, we've had 605 detections of five turtles from 39 different receivers off the coasts of Massachusetts, North Carolina, South Carolina, Georgia, and Florida. To date, maximum tracking duration has been 1,036 days for leatherbacks and almost one year for loggerheads. The duration of external acoustic tag detection in other cheloniid studies has generally been less than one year. The recent deployment of internal tags precludes comparison of maximum tracking periods between methodologies but results are promising. Acoustic tagging may provide a longer lasting and more affordable alternative to satellite tags for some research questions. However, given incision complications, refinement of surgical methods for tag implantation is needed.

STABLE ISOTOPES ASSOCIATED WITH SATELLITE TELEMETRY TO IDENTIFY FORAGING AREAS OF *LEPIDOCHELYS OLIVACEA* NESTING IN BRAZIL

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Sea turtles have a wide geographic distribution and can perform extensive migrations between nesting and foraging areas. Knowledge of the habitats used helps to understand the ecology of these animals, which is fundamental for their protection and conservation. In this study, we used stable isotope analysis ($\delta^{13}C$ and $\delta^{15}N$) in red blood cells and satellite telemetry data to identify the main foraging areas of female olive ridley turtles (*Lepidochelys olivacea*). During 2018 and 2019, thirteen females were equipped with satellite transmitters and blood samples were collected at the time of nesting, at Pirambu beach, in northeastern Brazil. Three main post-reproductive migration routes from the nesting site were identified based on tracking data: one oceanic destination (oceanic group) through equatorial waters towards the coast of Africa (n=6), and two neritic destinations (neritic group), one towards the north/northeast (n=2) and one towards the south/southeast direction of the nesting beach (n=4). For one individual it was not possible to identify the migratory destination due to the short period of signal transmission. The dwelling time in the foraging areas was obtained for eight females (4 neritic and 2 oceanic). Longer foraging times were recorded for the neritic turtles, ranging from 36 to 235 days (mean= 99 days, sd= 83.11; n=6), for two oceanic turtles, which stayed 26 and 31 days, respectively. Four of these turtles that established feeding areas showed two distinct foraging spots: the two oceanic turtles and two of the neritic females that followed the south/southeast direction. Cluster analyses were used to group the sampled turtles according to their blood carbon isotopic values. Two clusters were found: one with higher $\delta^{13}C$ values, suggesting the use of neritic regions (medoid= -17.3‰; n=4), and another group with lower $\delta^{13}C$ values, indicating the use of oceanic areas (medoid= -19.3‰; n=9). Ten of the 12 tracked turtles were correctly classified into the neritic and oceanic groups, corresponding to 83.33% of the samples, showing that $\delta^{13}C$ is a good predictor for identifying oceanic and neritic destinations in the post-reproductive migration of olive ridley turtles. Furthermore, large variability in stable isotope values was also found for neritic turtles ($\delta^{13}C$ mean= -17.6‰; sd= 1.5; $\delta^{15}N$ mean= 8.8‰; sd= 2.7) compared to oceanic ones ($\delta^{13}C$ mean = -19.1‰; sd= 0.3; $\delta^{15}N$ mean = 8.9‰; sd= 1.2). This larger isotopic range for coastal females is probably related to the variability in isotopic baseline values of habitats used along the Brazilian coast, and/or by different diet preferences. The association of techniques provided detailed results about the migratory destinations and foraging areas of the females, demonstrating a complexity of spatio-temporal patterns in the use of food resources that suggests a generalist species both in feeding behavior and migratory destination, but probably composed of a mixture of specialists and opportunistic individuals. Furthermore, the results obtained through stable isotope analysis provided a new perspective for using these biochemical tracers that allow obtaining more representative sample numbers at the population level.

MICROHABITAT OF THE GREEN TURTLE (*CHELONIA MYDAS* LINNAEUS, 1758) ON A REEF IN THE CENTRAL GULF OF MEXICO

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The microhabitat of the green turtle in the Cabezo reef of the Veracruz Reef System National Park (PNSAV) was characterized. Data obtained from 47 turtles in the period from March 2018 to July 2019 were analyzed through visual censuses by navigations in the area. Reef bottom types and oceanographic parameters such as: depth (m), temperature (°C), dissolved oxygen (mg/L) and salinity (ppt), as well as time of detection, number of individuals and size classes were recorded by geographic coordinate. The microhabitat of *Chelonia mydas* at Cabezo reef is composed of seven reef bottom types. Oceanographic parameters recorded consisted of shallow water shallower than 2.4 m depth, water temperature of 24.8 to 30.3 °C, dissolved oxygen concentrations of 3.6 to 7.7 mg/L and salinity of 25.4 to 38.1 ppt. The turtle was evenly distributed across the different bottom types. Temperature is the parameter with significant variation in relation to the reef bottom. The highest abundance of turtles was distinguished in the rainy season and composed mostly of juveniles, from 10:00 am to 12:00 pm. Cabezo reef seems to present the oceanographic conditions and the necessary resources for the development of juvenile *Chelonia mydas*, however, the current management plan may not have the appropriate restrictions for the site in question, which has the characteristics to be considered as a possible priority habitat.

WHERE DO HAWKSBILL AND GREEN SEA TURTLES GO DURING INTERNESTING IN SÃO TOMÉ ISLAND

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The Hawksbill Sea turtle nesting population of São Tome Island is considered one of the 11 most threatened sea turtle populations in the world and the last remaining aggregation in the region with a unique genetic haplotype and low genetic variability. The Green Sea turtle is the most common in the archipelago, nesting on virtually all sandy beaches of both the island, exhibiting relatively high levels of genetic diversity and

distinctiveness, representing an important genetic pool in the region. Both species still face several threats in the country, such as intentional harvest, fisheries by-catch, habitat degradation, pollution, and offshore oil exploration. Little is known about these species nesting in São Tomé Island away from the nesting beaches, thus the identification of high-use areas during their internesting period is crucial for adequate and effective conservation. We equipped with Fastloc satellite tags 5 Green and 10 Hawksbill Sea turtles nesting in Sao Tomé Island and tracked them during their internesting period. Besides their locations, vertical movements such as dive depth and durations were also analysed. During the internesting period, both species spent most of their time in a particularly small area in the vicinity of the nesting beaches, presenting small core-use areas (50% kernel density estimate) of 0,027 km2 for hawksbills and 0,033 km2 for green turtles. The daily distance travelled during the internesting period ranged from 0.4 to 15.3 km for hawksbill turtles and 2.8 to 8.9 kms for green turtles. While green turtles stayed in bays with very shallow waters in an average depth of 5 to 10 meters performing mainly dives of 5 to 10 minutes long, hawksbills prefer more exposed waters staying mainly between 10 to 15 meters deep, performing longer dives of 60 to 80 minutes. These results contributed as a baseline information and recommendations for the ongoing initiatives to create the first network of marine protected areas in São Tomé Island and to define strategies and management priorities to mitigate existing anthropogenic threats.

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*INTER- AND INTRASPECIFIC VARIATION IN TROPHIC ECOLOGY OF MARINE TURTLES: FREQUENCY, POTENTIAL DRIVERS, AND IMPLICATIONS FOR CONSERVATION

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The idea that interspecific variation in trophic morphology among closely related species effectively permits resource partitioning has driven research on ecological radiation since Darwin first described variation in beak morphology among Geospiza. Marine turtles comprise an ecological radiation in which interspecific differences in trophic morphology have similarly been implicated as a pathway to ecopartition the marine realm, in both extant and extinct species. Because marine turtles are charismatic flagship species of conservation concern, their trophic ecology has been studied intensively using stable isotope analyses to gain insights into habitat use and diet, principally to inform conservation management. This legion of studies provides an unparalleled opportunity to examine ecological partitioning across numerous hierarchical levels that heretofore has not been applied to any other ecological radiation. Our contribution aimed to provide a quantitative analysis of inter- and intraspecific variation in trophic ecology across different hierarchical levels marshalling insights about realised trophic ecology derived from stable isotopes. We explored the interspecific variation in trophic ecology in marine turtles in general, and the variation in resource use in one population of olive ridley turtles (*Lepidochelys olivacea*) in the Eastern Tropical Pacific (ETP) in specific using stable isotope data. We reviewed 113 stable isotope studies, mostly involving single species, and conducted a meta-analysis of data from adults to elucidate differences in trophic ecology among species. We further collected new stable isotope data for *L. olivacea* nesting in Costa Rica and compared trophic niche space among individuals of this population. Finally, we compared the trophic niche of our *L. olivacea* population to other marine turtle populations and species, and the group of marine turtles to other large marine vertebrates. Our study reveals a more intricate hierarchy of ecopartitioning by marine turtles than previously recognised based on trophic morphology and dietary analyses. We found strong statistical support for interspecific partitioning, as well as a continuum of intraspecific trophic sub-specialisation in most species across several hierarchical levels. This ubiquity of trophic specialisation across many hierarchical levels exposes a far more complex view of trophic ecology and resource-axis exploitation than suggested by species diversity alone. Not only do species segregate along many widely understood axes such as body size, macrohabitat, and trophic morphology but the general pattern revealed by isotopic studies is one of microhabitat segregation and variation in foraging behaviour within species, within populations, and among individuals. These findings are highly relevant to conservation management because they imply ecological non-exchangeability, which introduces a new dimension beyond that of genetic stocks which drives current conservation planning.

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*FIRST STUDY TRACKING MALE GREEN TURTLES (*CHELONIA MYDAS*) AT OGASAWARA ISLANDS REVEALED MIGRATION ROUTES AND MOVEMENT IN THE POST-BREEDING SEASON

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This study involved attaching satellite transmitters to adult male green turtles, and tracking their movements in the post-breeding season at the Ogasawara islands in Japan - a major green turtle rookery in the Northwest Pacific. Eleven male green turtles were caught during the breeding season. Satellite transmitters were attached to each turtle, and they were subsequently released and tracked for up to 450 days (currently ongoing). The study revealed detailed migration routes and movements of male green turtles after a breeding season ended at the Ogasawara Islands. Two of the eleven turtles did not migrate north to the foraging grounds, and remained at the breeding grounds around the Ogasawara islands even after the breeding season ended. One of the two turtles was observed mating underwater 230 days after being released. This suggests that some male turtles are able to breed two consecutive years in a row without having to return to their foraging grounds after every breeding season. On the contrary, our current data suggests most females in the Ogasawara population re-migrate to the islands every four years to breed, suggesting the sex differences in breeding periodicity as reported in the other population. The other nine turtles migrated to foraging grounds along the coastal areas of mainland Japan, located approximately 1100 km north of the islands. These turtles started migrating north within 30 days of being released from the breeding grounds. They all took almost the same route to the foraging sites, diving down to a maximum of 70m during the migration. This study showed that there is no significant difference for Ogasawara population between the males' foraging grounds and females' foraging grounds that were previously reported. After the male turtles arrived at the coastal foraging grounds, no significant movement was observed. This study suggests that there are differences in breeding ecology between sexes, such as remigration intervals for breeding. However, there are also common ecological aspects between both sexes, such as foraging site selection. This study provides important implications for further understanding of sea turtle reproduction and male ecology, which could be vital when establishing conservation strategies under a warming environment.

MIGRATION AND ISOTOPIC NICHE OF GREEN TURTLES FROM POILÃO ISLAND, BIJAGÓS ARCHIPELAGO (GUINEA-BISSAU)

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Green turtles are distributed in the tropical, subtropical and warm temperate regions of the world's oceans, and use foraging areas far from their breeding areas, which makes them highly migratory species. In adulthood, they tend to be herbivores, although there is some variety in the diet. In the Bijagós archipelago (Guinea-Bissau), the island of Poilão hosts the second largest breeding populations of green turtles in Atlantic, with 27,000 clutches laid annually on average. In this study, post-nesting migrations and the isotopic niche of green turtles that nest in Poilão were investigated. During four years (2013, 2014, 2016 and 2018) we collected biopsy samples from 200 green turtles (epidermis from the shoulder area), while they were laying eggs at Poilão, to analysed their carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotopic signatures. Additionally, we deployed satellite tracking devices on a subset of 16 nesting females, in 2018. Post-nesting migrations revealed new feeding areas for this population, namely in Bijagós (n = 5), Senegal (n = 3) and Gambia (n = 1). In addition, seven animals migrated to a previously identified area in Mauritania. Significant differences were observed in turtle sizes depending on their feeding area (F=6.785, df=2, P=0.0096; Bijagós: curved carapace length (CCL) = 88.2 cm ± 6.9 cm, Senegal and Gambia: CCL = 95.7 cm ± 6.2 cm, Mauritania: CCL = 102.8 cm ± 7.1 cm). There were also significant differences in isotopic signatures between years ($\delta^{13}C$ KW=21.089, df=2, P=0.0263; $\delta^{15}N$ KW=14.705, df=2, P=0.0006). Turtles with ≤ 95 cm CCL occupied a more restricted trophic niche and, while turtles with CCL > 95 cm presented a more comprehensive niche.

*DISPERSAL OF JUVENILE LEATHERBACK TURTLES FROM DIFFERENT CARIBBEAN NESTING BEACHES: A MODEL STUDY

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The Northwest Atlantic (NWA) leatherback turtle (*Dermochelys coriacea*) subpopulation was recently classified as endangered. It nests in the Wider Caribbean Region and includes five genetic stocks, all declining, albeit at different rates. The causes of decline are multiple and difficult to identify based on annual nest counts which integrate the effects of multiple stressors over the entire life history. Demographic models, however, show that survival during the juvenile pelagic stage is the main factor modulating population trends, but this life stage remains largely unobserved. This paper presents a suite of numerical simulations where juveniles from the five NWA stocks disperse under the combined effects of ocean currents and habitat-driven swimming movements. Simulations reveal when and where NWA juveniles likely disperse and, thus, the environmental conditions and anthropogenic threats they may encounter. Simulated individuals initially disperse following either the "Caribbean route," inside the Caribbean Sea and the Gulf of Mexico (GoM), or the "Atlantic route" east of the Antilles Islands Arc. The percentage of individuals following one or the other route varies markedly with the stock of origin. Late dispersal in the eastern Atlantic Ocean and the Mediterranean Sea is similar in all stocks. Juveniles following the Caribbean route are rapidly entrained northwards by the Gulf Stream and incur a high risk of cold-induced mortality. This mostly affects the Florida stock and the Western Caribbean (WCA) stock nesting in Costa Rica, Panama, and Colombia. The Atlantic route is less lethal as individuals progress more slowly toward higher latitudes. Simulations also show that the percentage of WCA juveniles visiting the GoM is larger than for any other stock. The learned migration goal (LMG) hypothesis, which posits that adult sea turtles tend to exploit foraging areas previously identified at the juvenile stage, may thus explain why WCA adults are overrepresented in the GoM. Finally, our results suggest that the recently observed increase in the percentage of WCA adults migrating into the GoM could be linked to bycatch reduction measures implemented in 2003–2004, combined with an increase in the frequency of Loop Current intrusion and eddy-shedding events that started around the year 2000.

THE BOYS ARE BACK IN TOWN? ADULT MALE GREEN SEA TURTLES (*CHELONIA MYDAS*) BREEDING MIGRATIONS IN THE HAWAIIAN ISLANDS

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Basking on land is uncommon throughout the global range of the green sea turtle (*Chelonia mydas*). However, this behavior has been documented in Hawai'i, USA. There, green sea turtles, or honu in Hawaiian, frequently haul out on beaches and bask diurnally and nocturnally. This relatively unique behavior offers the rare opportunity to study mature male sea turtles, which are often less researched than their nesting female counterparts. Honu nesting is primarily concentrated in the Northwestern Hawaiian Islands around the Papahānaumokuākea Marine National Monument; over 96% of the population nests at Lalo (French Frigate Shoals). This remote atoll currently comprises seven islets located approximately 700 km from the main Hawaiian Islands. During nesting season, mature males bask throughout the atoll in high numbers and can regularly be observed copulating with females in water near the shoreline. Satellite transmitters were used to investigate several aspects of male honu ecology, expanding on pioneering research conducted in the 1990s. From 2018 to 2022, 10 Wildlife Computers SPLASH10-F-297A tags, which give both ARGOS and Fastloc GPS locations, were deployed on adult male honu at Lalo (n = 8) and on O'ahu (n = 2), located in the main Hawaiian Islands. Tags transmitted on average 164.5 days (range: 32-366), excluding four tags actively transmitting as of October 25, 2022. Satellite telemetry data revealed adult male honu have a potential variation in breeding strategy within the population. All eight post-mating males tagged at Lalo migrated to the main Hawaiian Islands, where they settled in what is assumed to be their permanent foraging grounds. The two "resident" males tagged on O'ahu, which were documented copulating, remained in nearshore waters off the island throughout the duration of the nesting season. Our results suggest two distinct mating strategies exist for male honu. In one, an unknown proportion of the males migrate and congregate with females off of nesting beaches, and in the other, a proportion focuses mating efforts near foraging grounds. Resident behavior may potentially allow for annual mating by eliminating resource-depleting migrations. However, they would have reduced access to females compared to those migrating to Lalo. Our research suggests that residents may represent a distinct proportion of the male population that reproduces solely within the main Hawaiian Islands. Previous basking sightings and fine-scale telemetry data indicate an additional variation of habitat use within Lalo among the males that migrate. Some males displayed strong site fidelity (n = 5), repeatedly basking on or transmitting near individual islets, while a smaller proportion of males (n = 3) utilized additional areas within the atoll, traveling to islets within Lalo approximately 20 km away. These data suggest individual plasticity regarding breeding-site selection which could be beneficial in such a dynamic atoll. These findings can also help answer questions regarding how many males contribute to the breeding population and how many it takes to sustain the population. These answers are critical for green sea turtle conservation in Hawai'i.

QUANTIFYING THERMAL HABITAT OF SEA TURTLES ASSOCIATED WITH SARGASSUM FORMATIONS IN THE SARGASSO SEA

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The Sargasso Sea is an aggregation of drifting formations of *Sargassum* algae across >4 million km^2 in the North Atlantic. Pelagic *Sargassum* formations are hubs of biodiversity, providing nursery and foraging habitat for associated fauna, including juvenile sea turtles. *Sargassum* formations may also provide warmer environments for developing organisms by absorbing solar energy and reducing water movement and heat dispersal, thereby increasing water temperature relative to open water. However, thermal characteristics of *Sargassum* formations have not been quantified *in situ*. In light of rising global sea surface temperatures (SST), evaluating thermal profiles of *Sargassum* formations is critical for understanding potential impacts of climate change on *Sargassum* ecosystems. To evaluate whether *Sargassum* formations provide warmer environments, we assessed daytime temperature differentials between *Sargassum* mats (n = 50) and nearby open water in the Sargasso Sea. We visually estimated mat length and width to the nearest 0.25 m. Using a YSI Pro20i temperature probe rigged to an extendable pole, we measured SST at 0.5-m intervals along a transect from mat edge toward mat center. At each horizontal position, we also measured temperature at 0.2-m depth increments down to 1 m. After measuring temperatures, we snorkeled into each mat to measure mat thickness to the nearest 0.2 m at each horizontal position. For each mat, we quantified temperature in nearby open water ca. 5 m away at 0.2-m depth increments from the sea surface down to 1 m. We (1) compared SST in *Sargassum* mat center and in nearby open water (paired samples Wilcoxon test); (2) evaluated the relationship between mat dimensions and SST differential (linear regressions); and (3) quantified water temperature gradients inside and below mats and compared them to nearby open water (Kruskal-Wallis tests and post-hoc Dunn's tests with Bonferroni correction). SST in the center of mats was significantly higher than in nearby open water ($p < 0.01$), and SST differential was independent of mat dimensions. SST differential between mat edge and open water was smaller than those between mat center and edge, and between mat center and open water (adjusted p-values <0.01). Water temperature was significantly higher inside and below mats compared to open water (adjusted p-values <0.01) but did not vary inside mats with depth. Though temperature differentials were narrow over the range of mat sizes we encountered, *Sargassum* formations provide warmer environments for associated fauna. Because the highest temperatures were recorded in larger mats, we provide a hypothetical curve describing variation in SST differential with *Sargassum* formation size as a prediction for future studies to evaluate. Temperature affects growth rates, behavior, and fitness of organisms. Developing sea turtles and other marine ectotherms may benefit from the warmer microclimate in *Sargassum* formations. However, under future climate conditions, temperatures in *Sargassum* formations would exceed upper thermal limits of associated species before temperatures in open water. Our study provides a foundation for predicting impacts of global climate change on the suitability of this thermal habitat for *Sargassum*-associated fauna.

*PHOTO IDENTIFICATION AS A TOOL TO STUDY SEA TURTLE POPULATIONS IN KENYAN MARINE PROTECTED AREAS

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The limited data on foraging and developmental habitats of sea turtles along the coast and on turtles migrating out of Kenyan waters hinders our understanding of the full extent of threats to these populations. The Diani-Chale National Marine Reserve, located on Kenya's south coast, was legally designated in 1995 as a result of an integrated coastal management pilot project, but failed soon after due to intense conflict between Kenya Wildlife Service (KWS) and local communities over benefit use. A sea turtle photo ID program initiated in July 2018, and is currently managed by the Olive Ridley Project (ORP). The program has been used to obtain discrete information about individuals' locations at a given time, which is essential knowledge for spatial planning and conservation management of endangered species, as well as to create a baseline for juvenile green turtle foraging populations in the south coast of Kenya. Photos include one or both sides of the turtle's faces to allow ID and stored on a database with associated metadata. Data collected includes species, carapace length estimation, encounter location and depth, habitat preference, and behaviour. In a three-year nine-month period, from July 2018 to December 2022, ORP has recorded 3,200 sea turtle encounters, 2,750 of 549 individual green turtles (Chelonia mydas), and 441 encounters of 62 individual hawksbill turtles (Eretmochelys imbricata). Nearly half of the turtles (48%) have been re-sighted, showing strong site fidelity. Data shows the importance of this protected area as a sea turtle foraging aggregation with strong site fidelity. However, the preferences for shallow, nearshore habitats are likely to increase the encounter risk with artisanal fisheries and tourism activities. This pioneer work in Kenya has since expanded to 3 more marine protected areas in Kenya and has become the basis for an in-water sea turtle juvenile population monitoring network.

PHOTO-IDENTIFICATION OF EASTERN PACIFIC HAWKSBILL TURTLES IN NAYARIT AND JALISCO, MEXICO

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The availability of underwater cameras at accessible prices has led to their adoption by recreational divers, fishers and other ocean enthusiasts. This has created the opportunity for community science where members of the public share their photos and videos with researchers. In March 2020, we launched a photo identification project in Bahia de Banderas on the Pacific coast of Mexico to recover information collected on sea turtles by divers and raise awareness of the presence of hawksbill turtles in the region. We used the Interactive Individual Identification System software: I3^{S} Pattern to photo-identify facial patterns of hawksbill turtles (*Eretmochelys imbricata*) captured during research coordinated by Grupo Tortuguero de las Californias A.C. and free-swimming individuals photographed or filmed by divers. As a result, we

received 652 images of hawksbill turtles taken at 19 sites by our researchers and community members. In total, 205 hawksbill turtle individuals were photo-identified, of which 3 were males, 12 females and 190 juveniles of indeterminate sex. In addition, we registered four possible hybrids of hawksbill with the east Pacific green turtle (*Chelonia mydas agassizii*) using the photographs taken. Of the registered hawksbill turtles: 170 turtles (82.9%) were captured or photo-identified in unprotected areas, 22 turtles (10.7%) inside National Parks (Islas Marías and Islas Marietas), and 13 (6.3%) in a municipal (Los Arcos de Mismaloya) or community (Coral Island, Jaltemba Bay) protected area. Sea turtle conservation in Jalisco and Nayarit has concentrated on olive ridley nesting beach monitoring; however, our results highlight the area's importance for juvenile hawksbills, which are present year-round.

DIATOMS AS INDICATORS OF GREEN TURTLES *CHELONIA MYDAS* HABITAT USE IN COASTAL WATERS OF URUGUAY (33°-35° S)

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Generally, diatoms are the most abundant microorganism of the primary biofilm found over turtle carapace and additionally they have great potential as bioindicators. The study of turtle macro epibionts could help to understand the habitat use of sea turtles. However, diatoms could reveal ecological data that reflect habitat changes more precisely than macro epibionts, due to the large extension of diatom species and their respective ecological preferences. They can adapt to several environmental conditions such as contamination, salinity changes, trophic level and different substrates. Those substrates include sediments, rocks and other organisms like seaweeds, invertebrates and even vertebrates such as cetaceans and reptiles. Juvenile green turtles (*Chelonia mydas*) in Uruguayan coastal waters can present a lethargic behavior during winter. Based on previous studies conducted in Uruguay, through this period the carapace of the turtle is available to be colonized by benthic organisms as barnacles, mussels, hydrozoans and seaweeds. In our study area green turtles can be categorized in four states of carapace colonization: 0-without epibiota, 1-barnacles, 2-hydrozoans+seaweeds, 3-mussels+seaweeds. In the course of these succession stages the diatom community could change reflecting the environmental conditions experienced by the turtles. In this context, the objectives of this study are to characterize the diatom community associated with the carapace of green turtles and determine if there exists a relation between the diatom species and the epibiosis state. Our study is the first to characterize the diatoms associated with green turtle carapaces in the Southwestern Atlantic, including all seasons and different epibiosis states. A total of 30 stranded green turtles registered by the local NGO Karumbé were analyzed between 2018 and 2020. Turtles were classified according to their epibiosis state. We study the diatoms of 10 turtles in state 0, five in state 1, six in state 2 and seven in state 3. A total of 72 diatom taxa (including 37 genera) were identified. According to Simpson index-(S) a higher richness and equitability-(J) was identified in individuals associated to states 1-3, mainly at state 2 (S=0.89; J=0.70), related to a major substrate richness and availability provided by the turtle carapace. The state 0 showed a lower diversity (S=0.29), characterized by the dominance of *Achnanthes* cf. *elongata,* which is a species registered exclusively from sea turtle carapace. The most advanced states of epibiosis (2 & 3) presented a higher presence of freshwater species as *Aulacoseira granulata* and *Chrysophyte cysts*, probably indicating the use of streams, artificial channels and surrounding areas during the last period of the winter dormancy in Uruguayan coastal waters. Our results showed that diatoms could be considered as

proxies of lethargic turtles and to identify the high use areas of overwintering green turtles in this feeding area of the Southwestern Atlantic Ocean.

DIVING BEHAVIOR OF OCEANIC-STAGE LOGGERHEAD SEA TURTLES USING TRI-AXIAL ACCELEROMETER DATA LOGGERS

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Behavioral ecology of oceanic-stage of juvenile sea turtles remains enigmatic in many aspects, especially on diving behavior. In this study, we characterize dive performance and investigate the influence of environmental variables on juvenile loggerhead sea turtles (*Caretta caretta*) diving behavior. High-resolution multi-sensor tags were deployed on eleven juvenile loggerhead turtles in the Azores Archipelago. Eighteen dive variables related to three-dimensional and kinematic characteristics were extracted from a total of 174 dives. A k-means and hierarchical cluster analysis identified two dive types, yet with a large discrepancy in the partitioning of the data between methods. A principal component analysis (PCA) identified depth and bottom duration as the principal features influencing diving behavior, followed by the circular variance of heading, body angle (pitch and roll) and locomotory activity (vectorial dynamic body acceleration) during the descent and bottom phases. Generalized additive mixed models (GAMM) fitted to the main principal components derived from the PCA showed significant diel cycle and water temperature effects on turtles diving behavior. This study is part of an on-going project and it will support further research and help fill the main gaps on our knowledge of juvenile loggerhead sea turtles.

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*INTERACTIONS AMONG HAWAIIAN HAWKSBILLS SUGGEST PREVALENCE OF SOCIAL BEHAVIORS IN MARINE TURTLES

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Social behaviors represent a central tenet of ecology and evolutionary biology but remain widely undocumented in reptiles. Although marine turtles have been studied for decades, the prevalence, importance, and potential role of social behaviors have been largely overlooked. Consequently, marine turtles have predominantly been characterized as non-social animals in the literature. Here we present new evidence of social interactions for hawksbill turtles. We analyzed ten videos to assess the social interactions of four hawksbill turtles (3 adult females, 1 juvenile) that were resident on a nearshore coral reef along Western Maui, Hawai'i. We observed 149 interactions, which included head touching, biting, contact, pursuit, contest, and inspection. Head touching was the most common social interaction observed (n = 66,

44.3% of interactions) and is a largely undescribed behavior for marine turtles, which included beak swipes and gular pumping. The latter is particularly interesting as gular pumping generates a steady flow of water past the chemosensory organs and could allow the turtles to "smell" one another to exchange information. Biting was the least common behavior observed (n = 6, 4% of interactions), and was mainly exhibited by the juvenile (4 observations) to one of the adult females (2 observations). These results demonstrate that Hawaiian hawksbills display a complex array of social behaviors that extend beyond mating and courtship. These findings also coincide with relatively recent behavioral observations documented in green and loggerhead turtles, suggesting that nonreproductive social behaviors could be prevalent throughout the taxon.

ESTIMATING THE SEX RATIO OF ADULT OLIVE RIDLEY TURTLES IN THE MEXICAN PACIFIC: A BIOMETRIC STUDY

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Tail length is an important secondary sexual characteristic in adult sea turtles. However, information on male sea turtles is scarce due to the difficulty in accessing them. We measured curved carapace length (CCL), curved carapace width (CCW), total tail length (TTL), and vent to tip tail length (VTTL) to determine maturity stages of Olive Ridley Turtles (*Lepidochelys olivacea*). We studied 106 nesting females on a solitary nesting beach and 94 individuals offshore. Based on data from nesting females, we inferred the maturity stage and the individual sex of the turtles captured offshore. Mature males have a minimum CCL of 58.5 cm and average TTL of 27.8 cm (± 2.9 cm). Of the turtles captured offshore, 31.9% (n = 30) were identified as mature males, 36.2% (n = 34) as mature females, and 31.9% (n = 30) as immature. These results showed a 1F:1M sex ratio; the exact binomial test suggested no statistical differences in sex ratio among mature turtles. This finding contrasts with studies on hatchlings of Olive Ridleys that report a strong female bias induced by increasing incubation temperature due to climate change. The present study highlights the need for further research to correlate the adult sex ratio with the biased sex ratio of hatchlings that may affect the fitness of the Olive Ridleys, as well as its relationship with resilience to climate change, including sex-specific mortality.

*FORAGING ECOLOGY OF EASTERN PACIFIC HAWKSBILL SEA TURTLES: A HIGH-RESOLUTION STUDY IN A FORAGING GROUND IN THE GULF OF CALIFORNIA, MEXICO

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Hawksbill sea turtles are listed as Critically Endangered mainly due to degradation of nesting and foraging habitats and directed and bycatch mortality of juveniles and adults. Eastern Pacific hawksbill turtles constitute the most endangered population with perhaps less than 700 nesting females. In contrast to other hawksbill turtle populations, the Eastern Pacific population uses mangrove estuaries for both foraging and nesting. The Mexican Pacific is the northern limit of hawksbill distribution and of the mangrove distribution in the Eastern Pacific. Mangrove habitats also support many small-scale fisheries and, in the Gulf of California, are the source for over 30% of small-scale fisheries landings. Near shore marine protected areas (MPAs) are a successful and widely implemented fisheries management strategy. Strategies for the establishment of nearshore MPAs have expanded to explicitly include local users (particularly fishers) in their design and enforcement (Locally Managed Marine Areas – LMMAs). Hawksbill turtles may benefit from well-designed LMMAs because they concentrate in mangrove estuaries during the extended (20-30 year) subadult stage. Here we present the results of a hawksbill sea turtle's habitat utilization analysis on a foraging ground that comprises a mangrove estuary, a sandy-bottom habitat, and a rocky-reef habitat at San Jose Island, Mexico. The mangrove estuary was established as a LMMA in 2012 and is a known area of high hawksbill densities. Since 2014, we deployed 55 VEMCO acoustic coded tags on hawksbill turtles, linked to 10 acoustic monitoring receivers placed in the three habitats. We also deployed harness mounted video cameras for short term recording on 19 foraging turtles, we analyzed 13 fecal samples, and we conducted habitat surveys. Our results from 39 transmitting turtles indicate high habitat fidelity where 95% of the individuals stayed more than 75% of their time (over months and years) within the habitat where they were initially caught. In terms of behavior, we found that hawksbill turtles spend more time resting and swimming than feeding and searching. Based on the feeding behaviors and the fecal composition analysis, diet was dominated by sponges, colonial tunicates, red mangroves, green algae, and other invertebrates. Finally, the mean percent cover of these benthic food items was significantly greater in the mangrove estuary than in the other habitats. This study highlights the relevance of mangrove estuaries for the recovery of the Eastern Pacific population. Our results also suggest that high numbers of hawksbill sea turtles could be related to the protection enforced by local fishers. This knowledge brings an opportunity to identify additional mangrove sites for LMMA establishment for fisheries management and hawksbill protection in the Gulf of California.

*ENVIRONMENTAL FACTORS AFFECT DIVE DURATION AND SPACE USE IN JUVENILE CARIBBEAN HAWKSBILL SEA TURTLES (*ERETMOCHELYS IMBRICATA*)

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As ectotherms, sea turtle behaviors must be intricately linked to environmental conditions, but only a few studies link their behavior with the environmental conditions of their habitat. One would expect even small shifts in water temperature to significantly affect their metabolism and, therefore, their energy requirements, diving behavior, foraging behavior, rate of movement, and space use. Other factors such as wind speed, barometric pressure, wave height, time of day, habitat type, and seasonality could affect their behaviors. These factors were monitored in Brewers Bay and Hawksbill Cove St Thomas US Virgin Islands (18.342 N, 64.980W), where 17 juvenile hawksbills were hand captured and fitted with Vemco V13p or V16p pressure detecting acoustic tags to track their movements and dive behavior. As part of a multi-species research project, researchers maintained an approximately 100-hectare acoustic array that varied between 35 and 41 Vemco VR2W-69kHz receivers from 2015 through 2019, along with other sensors, including 13 HOBO temperature loggers providing water temperature profiles. Additional meteorological data were obtained from the nearby Charlotte Amelie Airport weather station. The residency index was 0.96 +/- 0.1, with turtles staying within the acoustic array for an average of 247 +/- 180 days, with the longest being 847 days and the shortest 38 days. Two turtles left the array most nights. Significant differences in dive duration (27.0 +/- 7.3 min vs. 46.0 +/- 8.6 min) and movement rate (652 +/- 114 meters/hour vs. 572 +/- 112 meters/hour) between night and day were found. Linear mixed-effects models (nlme in R) found that dive duration decreased as water temperature increased both during the day and at night. The average dive duration was reduced by 6 minutes when the water warmed from 26 to 30 C. Assuming the individuals maintained their oxygen stores, a temperature-related metabolic effect was estimated, resulting in Q10s of ~1.9 and ~2.3, respectively. The linear mixed model also showed significant effects of mean dive depth, wind speed, habitat type, and time of night (sub-period) on dive duration. Interestingly, water temperature did not appear to have a significant effect on space use, but air pressure and turtle size did. More space was used when the barometric pressure was lower, and larger turtles used more space than smaller turtles. The rate of movement increased with temperature and animal size during the day. However, at night only the effect of water temperature and barometric pressure was found to be significant on the rate of movement. This study determined the impact of many environmental factors on dive and space use patterns of critically endangered Caribbean hawksbills and has implications for the energetic and habitat requirements of these animals as they face climate change and an uncertain future.

*IDENTIFYING CRITICAL IN-WATER HABITAT FOR LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) NESTING AT SANDY POINT NWR, ST. CROIX USVI

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Marine animal movement occurs in response to biotic and abiotic factors – among them, predator avoidance, prey distribution, and ocean circulation. Movement studies are especially important for highly migratory species such as the leatherback sea turtle (*Dermochelys coriacea*), which use large geographic regions over space and time. Declines in Northwest Atlantic Regional Management Unit (RMU) populations of leatherbacks since 2009 have created an immediate need to fill knowledge gaps on the location and physical properties of their habitat preferences. The goals of this study were to identify where leatherbacks go during the interesting interval, to delineate important in-water habitats, and to determine environmental variables associated with high-use habitats. We deployed 10 Wildlife Computers SPLASH10 tags on nesting female leatherback turtles at Sandy Point National Wildlife Refuge (SPNWR), St. Croix, USVI during 2020 and 2021. We processed Fastloc location data in the Wildlife Computers data portal and used these data, in addition to haul out and nighttime nesting survey data, to determine nesting events. We created a home range estimate for the tagged individuals, using an Autocorrelated Kernel Density Estimation (AKDE) approach in R with the ctmm package, and summarized the habitat characteristics of the high-use area. We found that critical areas for leatherbacks are located in waters just offshore of SPNWR within 15 km of the nesting beach, as well as farther offshore on the northern side of St. Croix and in the oceanic trench between St. Croix and Puerto Rico. By mapping these home ranges, we can identify and protect important residence areas. We also found that, though most satellite-tagged leatherbacks returned to nest at regular intervals of 9-10 days, several individuals skipped one or several nesting events, resulting in internesting intervals such as 18 and 25 days. This suggests that current clutch frequency estimates, which assume a regular internesting interval (with no skipped nest events), may under-count nesting females. This information is critical for determining population level parameters that may affect recovery and have consequences for how population numbers are estimated.

*RESOURCE SELECTION BY GREEN TURTLES: INSIGHTS FROM FORAGING HABITATS AT THE NORTHERN EDGE OF THE EASTERN PACIFIC RANGE

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Effective habitat-based management for protected species requires information about how animals use local environmental resources through time and space. For sea turtles, satellite telemetry is a leading tool to indirectly observe habitat use. Through integrating telemetry with spatial environmental data, we can infer patterns in resource selection, that is, quantify associations with specific environmental factors.

Documenting such relationships allows managers to pinpoint and/or prioritize key habitat features. At the northern extreme of the East Pacific green turtle distribution in southern California USA, strong relationships with submerged aquatic vegetation (notably eelgrass *Zostera marina*) are assumed yet remain unquantified. We used GPS locations from 28 satellite-tracked turtles (n=1235 total tracking days; 2013–2022) foraging in the temperate, urban San Diego Bay to quantify associations between turtle movements, eelgrass, depth, and water temperatures. To evaluate selection, we assessed habitat parameters at locations actively used by turtles (i.e., GPS points) and determined that "selection" occurred if rates of resource use were disproportionately higher than what was "available" in the surrounding environment. We accounted for telemetry error and autocorrelation by including a weight term during modeling. Results from logistic mixed effects models (random effect for individual turtle) suggest an affiliation with the edges of eelgrass patches, selection for certain depth bands, and day-night differences in depth and temperature selection. We close by using models of green turtle resource selection to spatially predict probability of use within San Diego Bay. Our results reveal important, quantitative habitat associations for green turtles in the Eastern Pacific and, more broadly, provide a model for leveraging GPS locations to bolster habitat-based management.

INVESTIGATING TERRITORIALITY, RESOURCE PARTITIONING, AND ASSOCIATED MOVEMENT PATTERNS IN HAWKSBILL SEA TURTLES (*ERETMOCHELYS IMBRICATA*) USING FINE-SCALE POSITIONING ACOUSTIC TELEMETRY

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Understanding the habitat requirements and movement patterns of critically endangered species is crucial to improve management decisions aimed at the recovery of the species. Factors including resource partitioning and territorial behaviors will directly affect the space needed and the maximum density of hawksbill sea turtles (*Eretmochelys imbricata*). These protected animals require relatively shallow coral and rocky reef habitats during the 15 to 20 years of their juvenile development. During this time, hawksbills typically occupy small areas of less than 0.5 km^2. The carrying capacity of these developmental habitats is unknown, but intraspecific competition for these resources will likely lead to a maximum density that is influenced by behaviors such as territoriality. Brewers Bay and Hawksbill Cove, St. Thomas, U.S. Virgin Islands are known juvenile foraging grounds, providing an apt opportunity to investigate these behaviors. Many challenges exist in documenting competitive interactions in sea turtles; however, modern high-resolution tracking via fine-scale positioning acoustic telemetry systems (FPS) is a novel method used to detect associations between animals, and this study aims to utilize this technology to investigate patterns of spatial partitioning and intraspecific associations in hawksbill turtles. In June and July of 2021, we deployed a 59-receiver FPS array, spanning ~1.5 km^2, in Brewers Bay and Hawksbill Cove. We acoustically tagged 13 juvenile hawkbill turtles and tracked their fine-scale movements from August 2021 to September 2022. Preliminary results indicate that while there is some overlap in the overall space use of hawksbills, there is little overlap in concurrent activity spaces, suggesting individuals may be exhibiting avoidance behaviors. Various spatial and proximity-based analyses will be used to further determine hawksbill movement patterns and identify pairwise associations between individuals. This analysis of the hawksbill space use will incorporate the highest resolution data obtained for this species to date and provide results for a better

understanding of their habitat requirements and behaviors that influence the density of these critically endangered animals.

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*HAWAIIAN HAWKSBILL INTER-NESTING MOVEMENTS, DIVE BEHAVIOR, AND MIGRATORY PATHWAYS

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Hawksbill sea turtles (*Eretmochelys imbricata*) residing in the Hawaiian Islands constitute one of the smallest distinct sea turtle populations on the planet. The majority of the approximately 100 adult females estimated to be in the population nest on the islands of Hawai'i, Maui, and Moloka'i. Early research on the movements of post-nesting Hawaiian hawksbills implemented satellite tags that lacked the ability to collect high-resolution location (i.e., GPS) and dive data, restricting the ability of researchers to understand fine-scale movements and habitat use. Historically, tags were also often deployed late in the nesting season, limiting the ability to collect information on inter-nesting movement behaviors. Between 2013 and 2022 we deployed satellite tags on a total of 14 post-nesting hawksbills that collected information on Argos and GPS locations, as well as dive parameters (time at depth, maximum dive depth, and dive duration), with an emphasis of deploying tags early in the nesting season. The last transmitted locations for 11 of the 14 turtles were: seven off the coast of Maui, two off the coast of Moloka'i, one remained within Hawai'i island, and one off the coast of Oahu. No final location was transmitted for two turtles, and the transmitter failed on the remaining turtle. Generally, turtles used a single nesting beach and remained in close proximity (i.e., <2 km) to that beach throughout the inter-nesting intervals. We were also able to collect dive behavior on 12 of the 14 turtles. Both the horizontal and vertical movement data of these turtles are currently being analyzed, the results of which will be shared during the symposium. In doing so, we seek to identify key habitats and movement behaviors for this highly threatened population.

MOVEMENT PATTERNS OF GREEN TURTLES AT ONE OF THE LARGEST FORAGING GROUNDS: THE BANC D'ARGUIN, MAURITANIA

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Sea turtles are capital migrants which utilize distinct breeding and foraging habitats. By both fasting and undertaking energetically expensive activities during the breeding season, efficient resource uptake on the foraging grounds is fundamental to fulfill their biological cycle. Patterns of space use at foraging locations remains an understudied aspect at some key sites and for some sea turtle populations. We satellite-tracked 38 green turtles (*Chelonia mydas*), including 21 adult females, 3 adult males and 14 juveniles, to assess how immature and adult of both sexes use space within one of the largest foraging grounds for this species globally, the Banc d'Arguin in Mauritania, West Africa. Turtles exploited overlapping areas irrespective of their sex and life stage. Most tracked turtles remained within the delimitation of the Parc National du Banc d'Arguin (PNBA), except for a few females and juveniles that performed westward forays, where industrial fisheries are known to operate. They exploited two main foraging areas located around Agadir, in the north of the Banc d'Arguin, and west of Kiji and Tidra islands, to the south. Interestingly, green turtles exploited all known seagrass meadows (Zostera noltii and Cymodocea nodosa) - a main food source for this species – within the PNBA, except at the entrance of the Saint Jean Bay, the contour of Tidra Island and the coastline portion encompassed between Arkeiss and Ten Alloul. These seagrass patches may be poorly accessible to sea turtles because of coastal shallow depths combined with the tide cycle. A local discrepancy between the distribution of the tracked turtles and the seagrass meadows was also observed west of the PNBA, suggesting that the distribution of seagrass meadows is highly underestimated within the gulf of Arguin and/or that sea turtles exploit alternative food sources. More than half of the tracked turtles performed range shifts during the foraging period and switched between up to four distinct areas, with a few individuals returning to previously visited sites. These movements may be due to local depletion of seagrass meadows, abiotic conditions, or reflect a change in behavioral state. The restricted distribution of the tracked turtles with most locations falling within the PNBA suggests that the population has been benefiting from the management of this protected area in recent decades. However, the habitat of the tracked turtles overlapped greatly with artisanal fisheries and turtles exploited shallow sites even if deeper areas were available. A reduction of fishing activities in the shallowest areas of the PNBA, if sustainable for local communities, might benefit the turtles by preventing bycatch. The present study provides valuable ecological information, which may be useful to management authorities in the context of a fisheries zoning plan in the PNBA. Future work should investigate the fine-scale behavioral states of turtles within this major foraging ground and investigate the tidal, daily and seasonal effects on turtle distribution off Mauritania.

*SEA TURTLE CONNECTIVITY BETWEEN THE CUBAN SHELF AND OTHER AREAS

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The Cuban platform has favorable habitat conditions for different species of sea turtles. We updated, integrated, and analyzed existing information on sea turtle species connectivity between Cuba's nesting beaches and growing and feeding grounds with those of other areas within the Wider Caribbean region. We used updated mark-recapture data from Cuba (1959-2022) and satellite tracking information from Cuba and other countries in the Wider Caribbean region, totaling more than 90 tracks. Green turtles (*Chelonia mydas*) nesting on beaches of Cayo Largo and Guanahacabibes in Cuba, fed on marine grounds mainly in Nicaragua (Cayos Miskitos) and Panama, Honduras, and the United States. We report connectivity between feeding areas of the northeastern and southwestern regions of Cuba, where subadult sea turtles transit and feed, with nesting beaches in Costa Rica (Tortuguero) and Puerto Rico, respectively. We also report connectivity between the southeastern region of Cuba with feeding areas in Nicaragua - with juveniles and subadult sea turtles from the Jardines de la Reina archipelago feeding in Nicaraguan waters. Loggerhead sea turtles (*Caretta caretta*) travelled between nesting beaches south of Isla de la Juventud and Cayo Largo in Cuba to feeding grounds in Nicaragua and Belize, respectively. Hawksbill sea turtles (*Eretmochelys imbricata*) travelled between growing grounds in Jardines de la Reina, Cuba, to nesting beaches in Barbados and with feeding areas in Nicaragua and Colombia. Tags recovered in Cuba from other sites included those of green turtles' nesting beaches in Yucatan, Quintana Roo and Campeche (Mexico), Florida (US), Isla Aves (Venezuela), Virgin Islands and mainly from Tortuguero (Costa Rica). Tags recovered in Cuba also included green turtles from feeding and development areas of Bermuda, Bahamas and Grand Cayman, and nesting loggerheads mainly from Florida (US) and feeding areas of Mexico, The Bahamas, and Spain. Tags from hawksbill sea turtles nesting in Barbados, Virgin Islands, and Mona Island (Puerto Rico) were retrieved in feeding grounds in Cuba, as well as from hawksbills from Yucatán (Mexico), The Bahamas, and Los Roques (Venezuela). These tags have also shown nesting leatherbacks (*Dermochelys coriacea*) in Costa Rica in the waters of Cuba's southeastern region. Satellite tracking of turtles of different life stages from Cuba confirmed, for the three species, connectivity with the waters of Yucatan (Mexico) and Nicaragua and tracking of various sites in the Wider Caribbean region confirm that the Cuban platform constitutes a migratory corridor for these species within the region.

HABITAT SHIFT OF LOGGERHEAD SEA TURTLES IN SOUTHWESTERN ATLANTIC OCEAN REVEALED BY SATELLITE TELEMETRY AND STABLE ISOTOPES

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Loggerhead sea turtles (*Caretta caretta*) often undergo ontogenetic shifts, switching from oceanic habitat and pelagic prey to neritic areas and demersal prey. However, evidence has shown that this shift is not abrupt and could be reversible during development. Southern Brazil is an important feeding ground for juvenile and adult loggerhead turtles. We used two complementary approaches—satellite telemetry and stable isotopes analysis (SIA)—to study the loggerhead foraging strategies within, and recruitment between, oceanic and neritic habitats in the southwestern Atlantic Ocean. In our first approach, we used SIA of carbon and nitrogen in loggerhead turtle humeri and compared this with skeletochronology data to reveal the timing and age of recruitment from oceanic to neritic habitats along the coast of southern Brazil. From January 2008 to December 2009, humerus bones were removed from loggerhead turtles stranded dead (n = 19, mean ± 1 standard deviation curved carapace length - CCL = 75.0 ± 6.8 cm) along the Rio Grande do Sul coast (herein referred to as neritic turtles), and from individuals incidentally caught in the longline fishery (n = 16, mean CCL = 59.8 ± 4.2 cm) in southern Brazil (herein referred to as oceanic turtles). A total of 302 growth increments were sampled from the humeri of 35 individuals (mean = 9 increments per turtle) for SIA. We observed a marked increase in $\delta^{15}N$ values from inner to outer humerus annuli for 18 out of 19 neritic turtles, likely reflecting a transition from oceanic to neritic habitats. Among oceanic turtles, one individual exhibited a relatively high $\delta^{15}N$ value (12.9‰), indicative of at least some time spent in neritic waters. Based on CCL-at-age relationships and $\delta^{15}N$ values in skeletal growth increments, the mean age at transition was estimated at 13.3 years (range 8 to 18 years), with mean CCL at transition of 65 cm. For 11 turtles we observed a concomitant increase in $\delta^{13}C$ values, as expected for oceanic-to-neritic habitat shifts. In addition to SIA, we also deployed 17 satellite transmitters on loggerhead turtles (CCL = 76 ± 15.6 cm) incidentally caught in the bottom pair-trawl fishery along the continental shelf of Rio Grande do Sul coast; this included 10 juveniles of unknown sex and seven adults (six females, one male). Mean track duration was 336.3 (range: 52 to 783) days and turtles showed two patterns of habitat use: eight individuals remained in neritic coastal waters throughout the year, whereas five individuals showed a reversion on habitat use, returning to oceanic habitats, mainly during austral autumn and winter. Although, some tracked turtles moved back to oceanic areas, SIA revealed the permanent transition to neritic waters for most turtles. When combined, telemetry and SIA results suggest that loggerhead recruitment to the continental shelf of Brazil may be more flexible than previously thought. These complementary approaches were useful for the understanding on the foraging strategies and recruitment of loggerhead turtles in southwestern Atlantic Ocean.

TRACKING POST-RELEASE MOVEMENT PATTERNS IN NEW YORK'S REHABILITATED COLD STUNNED SEA TURTLES AND INSIGHT INTO UTILIZING OF LOCAL NEW YORK WATERS

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This project monitored the post-release movement pattern of 24 sea turtles rehabilitated at the New York Marine Rescue Center (NYMRC) located in Riverhead. The NYMRC rescues and rehabilitates all sea turtles stranding along the extensive coastline of New York. Of the 24 satellite-tagged turtles, 9 were Kemp's ridley (*Lepidochelys kempii*), 6 were Atlantic green (*Chelonia mydas*) and 9 were loggerhead (*Caretta caretta*) sea turtles. In New York, sea turtles strand for various reasons including entanglement, vessel interaction, malnourishment/debilitation, and cold stunning with many cases linked to human activities and overlap of shared resources between sea turtle and human populations. Between 2019 and 2022, NYMRC attached satellite tags (Wildlife Computers SPLASH and SPOT tags) to 24 of the 60 (40%) sea turtles that were rehabilitated and released. All sea turtles were approved for release by NYMRC attending veterinarians and release locations were pre-approved by NOAA Sea Turtle Stranding Coordinator. Data collected from these tags supports the rehabilitation efforts of NYMRC and illustrates the post-release movement patterns of successfully rehabilitated sea turtles. The hope is that all released turtles exhibit normal migratory behavior following rehabilitation. Preliminary data showcases southern or offshore movement patterns that have previously been associated with preferable post-release behavior. This data set provides ample support for the rehabilitation efforts of the NYMRC and suggests that sea turtles do resume normal movement behavior after receiving both short and long-term rehabilitation. Data from these turtles will also provide further about local foraging areas used throughout New York state waters in the late summer and early fall.

BEHAVIOR OF NEONATES-YOUNG *CARETTA CARETTA* IN HEADSTARTING PROCESS

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Headstarting is a strategy that seeks to protect vulnerable species such as sea turtles and where the applicability of ethology contributes to the knowledge and well-being of the specimens during their stay under human care. The Turtle and Marine Mammal Conservation Program (ProCTMM) carries out constant ethological studies on neonates-juveniles of the *Caretta caretta* species, with the aim of evaluating the behavioral response of the hatchlings, and its variation over time, as well as the identification of uses related to animal welfare. Currently, seven (7) studies have been fulfilled with individuals between 1 and 24 months of age, in which sampling has been carried out with a direct investigator and continues recordings applying the *ad-libitum* and animal-focal methods. These observations have made it possible to identify the periods of greater and lesser behavioral display, achieving the construction and enrichment of its ethogram, together with the quantitative description in terms of the frequency and duration of the states in relation to the size of the individuals. From a sampling effort of more than 280 hours, locomotion, feeding, spacing, agonistic,

grooming, hierarchy and exploration behaviors have been described with 89 events recorded in total. The period of greatest activity is between 6:00 and 18:00, while the spacing dominates in the remaining hours. During the first months of individuals, locomotion and spacing are the most representative. However, with the passage of time and the size of the hatchlings, the agonistic events in terms of duration increase, and the inversion of active states decreases from 60 to 42%, with a 58% prevalence in spacing in juveniles. The frequency in locomotion of neonates is associated with the swimming frenzy reported in its first stage and the reduction in activity in juveniles as an antipredatory strategy, as well as agonistic responses. However, since these are animals under human care, these variations in the display of active and inactive behaviors show the need to implement non-invasive environmental enrichment, modifying the complexity of the environment to reduce stress, agonistic events and atypical behaviors, which will stimulate behaviors of alert, search or exploration, foraging and interaction with other species. The ethology in these environments provides important information that suggests some aspects about the activity of the turtles in their lost years, likewise reflects the state and welfare of the animals, allowing the structuring and application of adequate strategies to improve their conditions during their stay in closed environments.

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*GUAM'S GREEN SEA TURTLES EXHIBIT MULTIPLE STRATEGIES FOR INTER-NESTING MOVEMENTS AND POST-NESTING MIGRATIONS INTO THE WESTERN PACIFIC

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Understanding the inter-nesting movement and reproductive migration of sea turtles is crucial for both international and local conservation, especially in the data deficient Central West Pacific (CWP) Distinct Population Segment (DPS), where green turtles (*Chelonia mydas*) are listed as endangered under the U.S. Endangered Species Act. Within the CWP, Guam and the Northern Mariana Islands are the only U.S. Territory and Commonwealth, respectively, where green sea turtle nesting occurs, but currently no data are available on the spatial ecology of Guam's nesting females. Further, there are limited studies available on the inter-nesting movements of green sea turtles in general, especially using high-precision GPS satellite tags. In this study, we equipped 16 nesting females with Fast-loc GPS satellite tags on five of Guam's beaches from 2016 to 2022 to elucidate inter-nesting movements and post-nesting migrations. We observed three patterns of movement during the inter-nesting period as well as three distinct migratory pathways. First, 11 of the 16 turtles exclusively used inter-nesting habitats adjacent (i.e., <2 km) to their nesting beaches. Second, four turtles demonstrated more vagile behaviors, traveling ~20–35 km along the coast of Guam to areas near other nesting beaches. Third, one turtle was observed traveling 238 km to a nesting beach on Saipan, north of Guam in the Mariana Archipelago. This turtle remained in Saipan for 69 days before returning to Guam, where it resided an additional 16 days before migrating to Indonesia. This individual nested in both Guam and Saipan, based on the 11-day inter-nesting interval observed for green turtles in the Mariana Archipelago. Combined, these findings highlight the importance of marine habitats adjacent to nesting beaches for females nesting at various locations. Fifteen of the 16 turtles departed Guam after completing oviposition, traveling to multiple countries in the Western Pacific, including the Philippines (n = 9), Japan (n = 3), Indonesia (n = 2), and the Spratly Islands (n = 1). Two of these turtles lingered in nearshore areas of Palau (7 days) and the Sorol Atoll in Yap, Federated States of Micronesia

(FSM)(<10 hours), before continuing on with their migration. Of the 16 tagged females, one turtle was essentially non-migratory, only traveling from its nesting site on the western side of Guam to the island's eastern coast, a straight-line distance of <15 km. Most turtles (n = 13) migrated in a relatively linear pattern until arriving at land masses near their final destinations, at which point they traveled along the coasts to foraging locations, where they remained for the rest of their tracking period. Three turtles migrated in either a non-linear (n = 1) or an S-shaped (n = 2) route. On average, deployment duration was about 216 days (n = 13, range = 44–441 days). Guam's nesting green turtles exhibit variability in both their inter-nesting and post-nesting movements. Despite these differences, our findings illustrate the importance of particular nearshore habitats around Guam and the Mariana Archipelago, as well as the need for international approaches for green turtle management in the Western Pacific.

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*IMPORTANCE OF NERITIC HABITATS ALONG MIGRATION ROUTE FOR ADULT HAWKSBILL TURTLES IN THE SOUTH-WEST INDIAN OCEAN

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The integration of movement ecology into the conservation of migratory species is an important step towards the implementation of appropriate and flexible management measures. The South-West Indian Ocean (SWIO) is recognized as an historically important region and is one of the world's most important breeding areas for the critically endangered hawksbill turtle. Given the wide distribution of coral and rocky reefs areas in the region, the SWIO also provides many foraging habitats for this species. Understanding the movements between these functional habitats is essential for estimating population connectivity. However, knowledge of the movements of hawksbill turtles in the SWIO is still lacking. Describing movement behavior requires the identification of the destination, the path taken to reach it but also the understanding of the movement along that path. This study proposes an analysis of the movements of 20 adult hawksbill turtles tracked from the SWIO with Argos satellite tags (SPLASH-10/MK-10, Wildlife Computers; KiwiSat Glue On Series, Lotek): 17 post-nesting females and 3 potential breeding males. We modeled movement along a dynamic continuum by estimating a continuous index of movement persistence for each location. In addition to a finer understanding of movement changes at the step scale, this approach allows for the contextualization of behavior with time-varying environmental parameters. We found a strong inter-individual variability in female migratory movements, particularly in terms of distance and movement persistence. On average, females spent 73% of their migration time on the continental shelf. In

the light of the environmental context, movement persistence decreases significatively with bathymetry. These results suggest that they use neritic habitats during the migration and are therefore at greatest vulnerability to coastal human activities. Of the three potential breeding males, one made a return trip from Moheli to Mayotte and the two others stayed in their capture area, close to the nesting beaches. Furthermore, we identified 14 foraging areas scattered throughout the SWIO where turtles have stabilized for an average of 215 days (min-max: 18-581d). All foraging areas were in coastal or remote neritic habitats: on the Mascarene plateau, in northern Madagascar, along the coast of Mozambique and at Moheli.These results reinforce the need to consider the importance of neritic areas, both for migration and feeding, in conservation issues for this species. The contribution of this study in filling the knowledge gap on the movements of hawksbill turtles in the SWIO will improve the understanding of population connectivity and discussions on the delineation of Regional Management Units.

GROWTH DYNAMICS OF JUVENILE HAWKSBILLS IN A MARINE PROTECTED AREA IN ROATÁN, HONDURAS

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ProTECTOR, Inc., USA

An important aspect of understanding population dynamics of a species is an understanding of growth rates of the population. For adult sea turtles, this may be problematic because of the relative difficulty of recapturing individuals over time in the wild. However, for juveniles who have strong fidelity to a relatively small home range, the ability to collect successive measures over time is much less problematic. These morphometric measures can provide data that are able to be calculated into annual growth rates. On the western end of the island of Roatán, Honduras, the Protective Turtle Ecology Center for Training, Outreach, and Research, Inc. (ProTECTOR, Inc.) has been collecting morphometric data on juvenile hawksbill turtles (*Eretmochelys imbricata*) in the Sandy Bay West End Marine Reserve (SBWEMR) since 2015. With each capture and recapture of individuals, we measured the minimum and maximum curved carapace length (CCLmin and max), curved carapace width (CCW), and weight (kg). From June 6 – July 5, 2022, we captured 5 individuals for the first time, and recaptured 12 individuals, for a total of 17 captures. Recaptures were positively identified by Inconel tags on the front right flipper, while new captures had tags applied to the front right flipper. We found growth rates of CCLmin ranged from 0.05 – 4.5 cm·yr-1, while CCW ranged from 0.58 – 4.27 cm·yr-1. Weight of individual juveniles ranged from 1.48 – 3.32 kg·yr-1. Years of recapture ranged from 3 years with 2 captures, to 6 years with 4 captures. These data provide further evidence of the site fidelity of juvenile hawksbills to small home ranges over a number of years, and that captures and recaptures provide important information on the growth and residence times of turtles within their home range habitats. Continuing studies on the habitat may provide evidence for habitat suitability, carrying capacity of juveniles, population dynamics, and age to maturity in this relatively small population. Further studies are needed to assess where turtles are recruiting from into this neritic habitat, and where turtles emigrate to on reaching maturity. New in-water studies are needed in other locations within the Bay Islands to investigate if other areas provide similar neritic habitats for juvenile recruitment, and to investigate if population mixing is occurring in this region.

POST-NESTING MOVEMENT OF LEATHERBACK SEA TURTLES FROM ANLOGA, GHANA, WEST AFRICA

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Leatherback sea turtle populations continue to decline across different management units around the globe. The primary threat to these populations is being captured as by-catch in commercial and artisanal fishing operations. Reducing this threat will require better knowledge of Leatherback movements as they migrate between foraging, breeding, and nesting grounds. In the Eastern Atlantic Ocean, Leatherback turtles utilize beaches from Senegal to Gabon for nesting. The coastal fisheries in this region create a risk for Leatherbacks once the females reach nearshore habitats. Still, they may also face considerable risk during offshore migrations by interacting with commercial fishers operating in the region. To assess this risk, we installed LoTek satellite tags on 10 female Leatherback sea turtles in Ghana during the last month of the leatherback nesting season (December 2022). We will present tracking data as the animals move out of the Gulf of Guinea and enter the open ocean habitat. Identifying the migratory route in this region will allow us to assess areas of the Atlantic Ocean that could be threatening to this species. This information is critical to inform management practices that reduce Leatherback interactions in the fisheries.

FIRST RECORD OF OLIVE RIDLEY SEA TURTLE (*LEPIDOCHELYS OLIVACEA*) IN MENDIHUACA AREA, MAGDALENA DEPARTMENT, COLOMBIAN CARIBBEAN

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Worldwide there are seven species of sea turtles that inhabit tropical and subtropical waters, four of them are present in the Colombian Caribbean: leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), hawksbill sea turtle (*Eretmochelys imbricata*), and green sea turtle (*Chelonia mydas*). The genera *Lepidochelys* is potentially distributed, with a nesting record of *L. kempii* in the Southern Colombian Caribbean and other occasional reports of the genera; its knowledge, including movements in the Colombian Caribbean is still limited. In 2017, the sea turtle and marine mammal conservation program ProCTMM (Programa de Conservación de Tortugas y Mamíferos Marinos) registred the first record of the olive ridley sea turtle (*Lepidochelys olivacea*) in Mendihuaca area, Magdalena Department (11°16'28.19" N- 73°51'30.64" O). The animal stranded dead in Mendihuaca river mouth, and morphometric measures were taken: CCL (curved caparace lenght) 65 cm, WCC (wide carapace lenght) 68 cm. Taxononomic determination was made according to its morphological features, including the number of costal shields, with a asymetric configuration of six shields on its left side and five shields on the right side, besides its typical olive color pattern for adults. Records of this species for the Colombian Caribbean are rare, therefore, the present record is an unusual sighting for the area, even so, fishermen in Mendihuaca area do not have a common name for it. In 2002 the Ministry of Environment of Colombia mentioned older records of *L. olivacea* for the Guajira department, known as "yellow turtle" (due to its smaller size), or Aítppise, as known in the Wayuunaiki language, that means "soft and smooth turtle", suggesting that this species was more frequent in previous years, and the decline of its populations is attributed to its overfishing

by local fishermen communities. This record is a very important contribution to the knowledge of the distribution and current habitat use of the species in the Colombian Caribbean.

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*'LOST YEARS' SEA TURTLE DISPERSAL IN THE GULF OF MEXICO

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Sea turtles in the life stage known as the 'lost years' remain the most difficult to observe and study, particularly among the species with broad oceanic dispersal after hatching. The goals of this research were to 1) evaluate early juvenile sea turtle movements in the Gulf of Mexico relative to the traditional definitions of sea turtle life stages; 2) compare turtle movements to passive oceanographic drifters for evidence of swimming behavior; and 3) examine potential neritic recruitment events to better describe where and when transitions between oceanic and neritic habitat use occur. Between 2011 and 2022, we sampled, tagged, and released 114 'lost years' turtles across four species: green turtles (*Chelonia mydas*; n=79), Kemp's ridleys (*Lepidochelys kempii*; n=26), loggerheads (*Caretta caretta*; n=5), and hawksbills (*Eretmochelys imbricata*; n=4). Turtles ranged in size from 12.3-29.9 cm with an average size of 18.7 cm (SD 3.1). To track post-release movements, we affixed Microwave Telemetry 9.5 g solar-powered Argos PTTs to wild-caught turtles from the Gulf of Mexico. We deployed a pair of oceanographic drifters at each turtle release to evaluate active versus passive movements. We used a Bayesian hierarchical correlated random walk model to interpolate positions for 112 turtles and 64 drifters at 12-hour intervals, followed by a hierarchical switching state space model to evaluate behavioral states. The average turtle tracking duration was 37 days (SD 21.9). Behavioral states differed between turtles and drifters, as did the frequency of positions in water depths <200 m defined as over the continental shelf, indicating the importance of turtle behavior on their net movement and habitat associations. Nine turtles traveled via the Gulf Stream around the southern tip of Florida to the North Atlantic. Few if any turtles recruited to neritic habitats within the tracking period and many appeared to orient away from the coast. Turtles did not approach shore as closely or strand on shore as drifters did. In addition to differences between turtles and drifters, species-specific differences among turtles were also apparent. For instance, considering occurrence over the continental shelf, 64.9% of Kemp's ridley positions were over the shelf while only 9.6% of loggerhead positions occurred over the shelf. Our results show that the waters over the continental shelf, particularly the West Florida Shelf, are important for juvenile sea turtles in the Gulf of Mexico. Early sea turtle life stages are often defined by location with respect to the continental shelf; however, the term "oceanic stage" may not reflect true habitat use of the life stage in the Gulf of Mexico. These data represent the most comprehensive tracking data for wild-caught dispersal-stage juveniles to date, offering a glimpse into the 'lost years' which will improve conservation and management plans to ensure their persistence in the future.

POST-NESTING MOVEMENTS OF LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) OFF THE SOUTHERN COAST OF BIOKO ISLAND, EQUATORIAL GUINEA: A PRELIMINARY REPORT

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The leatherback sea turtle (*Dermochelys coriacea*) is listed as globally vulnerable and in decline on the IUCN Red List; however, data for the Southeastern Atlantic population is currently identified as deficient. Bioko Island, Equatorial Guinea is widely recognized as an important nesting location for the Southeastern Atlantic population. To date, there has been little effort to track post-nesting movements of leatherbacks nesting on Bioko Island's beaches. Furthermore, human activities, such as fisheries and offshore oil exploration, increasingly threaten the region’s sea turtles. The objective of this study is to monitor and catalog leatherback inter-nesting habitat use and post-nesting migratory behavior. We deployed lightweight Desert Star SeaTag-MOD solar powered satellite transmitters to identify inter-nesting site use and post-nesting movements, illustrate potential migratory corridors, and locate distant or local foraging grounds utilized by nesting leatherback populations of West Africa. Overall, we will report on the movements and behavior of six leatherback turtles tagged in January 2023 with the expectation of contributing to a broader understanding of the at-sea ecology of the region’s leatherback populations, while assisting stakeholders in minimizing anthropogenic impacts.

IS THE VIRRILÁ ESTUARY IN NORTHERN PERU A NEW FORAGING AREA FOR JUVENILE HAWKSBILL TURTLES?

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The Virrilá Estuary (05°50’S; 80°50 W), located in Sechura Bay northern Peru, is the only estuary of the Peruvian territory and is located in an Ecotone / transitional area between the cool Humboldt Current Region with high primary productivity and strong upwelling, and the tropical Panamaic province. In-water surveys and stranding events were carried out from 2011 to date (2022). From a total of 1685 stranded seaturles, 99.6% was the East Pacific green (*Chelonia mydas agassizii*) and only 0.4% (n=7) were hawksbill turtles (*Eretmochelys imbricata*), all of them were found death in the inner part of the estuary, all being juveniles (mean CCL 41.5±3.8 cm (range: 34.7 - 51.2), head width (mean 56.4±4.9 mm (range: 51 - 68), a great percentage of the specimens were cadaveric or mummified (43%), then advanced and moderate decomposition with an equal 28.5%. Two specimens were fully infected (over 80% of the carapace) with balaniform epibionts such as *Chelonibia testudinaria*, *Platylepas hexastylus*, *Stephanolepas muricata*, *Jellius* sp. 30% of the recorded specimens presented evidence of strong collisions that could have caused their death, such as deep cuts in the head, and fractured shields in the carapace and in the plastron and carapace, probably due to artisanal boats propellers. It is hypothesized that juvenile hawksbill turtles could be making use of the internal parts of the Virrilá Estuary, where they have been registered up to 20 km inland, unfortunately we have not registered live specimens in the area, the entire estuary is included within the Environmental Conservation Area (ACA) so conservation actions should be strengthened on this critically endangered species.

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*FORAGING ECOLOGY OF EAST PACIFIC GREEN TURTLES (*CHELONIA MYDAS AGASSIZII*) IN PERU: RELATIONSHIPS WITH ONTOGENY AND ENVIRONMENTAL VARIABILITY

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Feeding strategies in sea turtles are among the most important aspects of their life history, influencing demographic parameters such as growth, age-at-maturity, and reproductive migrations. However, studying sea turtle diet is often challenging and knowledge about foraging ecology is lacking for most populations worldwide. We studied the East Pacific (EP) Green Turtle (*Chelonia mydas agassizii*) at two disparate sites in Peru: La Aguada, Paracas (~ 14°S), an area with cool upwelling conditions (mean 19°C), and Virrilá Estuary (~ 5°S) with year-round warmer conditions (mean 25°C). We conducted (1) in-water capture to assess population size structure and (2) esophageal lavages to recover diet components from turtles at both study sites. Diet composition and feeding strategy were evaluated using several analytical approaches, including esophageal lavages, and environmental influence on diet was assessed in relation to the Peruvian Oscillation Index and local Sea Surface Temperature. Our results indicate substantially different life stages and diets at the two study sites. EP Green turtles at La Aguada were mostly juveniles consuming animal matter, mainly sea anemones (*Paranthus* sp.) and jellyfishes (*Chrysaora plocamia*), whereas turtles at Virrila Estuary were mainly sub-adults with a diet dominated by vegetal matter, mainly sea lettuce (*Ulva papenfussi*) and *Caulerpa filiformis*. Our results suggest a life-history-based habitat use model for green turtles in the southeastern Pacific Ocean. We propose that juvenile EP green turtles initially recruit to more southern neritic habitats of Peru (Paracas), feed on high-caloric animal matter, then as individuals grow, they transition northwards to feed on lower-caloric, but abundant, vegetal matter. Our data provide a framework for ontogenic-based developmental migrations by EP green turtles in this portion of the southeastern Pacific Ocean, helping policymakers on the need to implement management strategies.

*DIETARY PLASTICITY LINKED TO DIVERGENT GROWTH TRAJECTORIES IN A CRITICALLY ENDANGERED SEA TURTLE

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Mechanisms linking foraging habitat quality and sea turtle demography are poorly understood. Here, we evaluate whether diet variation associated with alternative dispersal patterns is linked to regional growth variation in neritic stage hawksbill sea turtles (*Eretmochelys imbricata*), which grow significantly more slowly in Texas versus Florida (USA). Our approach included novel integrations of skeletal growth, gastrointestinal content (GI), and bulk tissue and amino acid (AA)-specific stable nitrogen ($\delta^{15}N$) and carbon ($\delta^{13}C$) isotope analyses to compare and contrast regional patterns of diet composition, trophic niche breadth, and growth. We also used AA $\delta^{15}N$ ΣV values (heterotrophic bacterial re-synthesis index) and $\delta^{13}C$ essential AA (δ13CEAA) fingerprinting to test assumptions about energy sources fueling hawksbill food webs. GI content analyses revealed that relatively fast-growing hawksbills stranded in Florida conformed with the widespread pattern of extensive spongivory. In contrast, relatively slow-growing hawksbills stranded in Texas, at the northern limit of the range, consumed considerable amounts of non-sponge invertebrate prey and appear to forage higher in the food web, as indicated by broader isotopic niche metrics and higher trophic position estimates. However, regional differences in estimated trophic position may also be driven by unique isotope dynamics of sponge food webs. AA $\delta^{15}N$ ΣV values and δ13CEAA fingerprinting indicated that eukaryotic microalgae and not bacteria were the primary energy source supporting hawksbill food webs, contrasting with evidence that hawksbill diets predominantly comprise high microbial abundance sponges expected to derive energy primarily from bacterial symbionts. Our findings suggest alternative foraging patterns could underlie regional variation in hawksbill growth rates, as divergence from sponge prey might correspond with increased energy expenditure and reduced foraging success or diet quality. As a result, differential dispersal patterns may incur substantial individual and population fitness costs and thus represent a previously unrecognized challenge to the recovery of this critically endangered species.

*TRACKING MALE TURTLES FROM AMVRAKIKOS GULF: AN IMPORTANT FORAGING AREA FOR LOGGERHEAD TURTLES IN GREECE

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ARCHELON has been carrying out an in-water capture mark recapture programme in Amvrakikos Gulf since 2002, making it the longest running programme at a foraging area not adjacent to a breeding site in the Mediterranean. This work has established the gulf as an important foraging area for loggerhead turtles in Greece, with direct links to breeding sites in Greece, through tag recaptures, and inferred links to breeding sites in Turkey and Cyprus from genetic analysis. During the summer fieldwork periods captures of adult-sized turtles are male-biased, possibly due many adult females being absent for breeding. We deployed eight Argos satellite tags on seven adult sized male turtles. Three transmitters were deployed on turtles in October 2020, and five were deployed in June/July 2021 (one turtle from 2020 was recaptured and equipped with a second transmitter in 2021 as the original transmitter had been dislodged). Maturity status of turtles was inferred from tail length (the distance the tail extended past the end of the notch between the two supracaudal scutes). A tail length of at least 20cm was used as minimum. One tracked turtle had a tail of this minimum length. The tail length of the remaining six turtles ranged from 25 to 31cm. The aim of the tracking project was to determine if 1) adult male loggerheads undertook annual breeding migrations and 2) which breeding areas were being frequented by male turtles from Amvrakikos. All transmitters from 2020 provided locations until at least 24 May 2021, which is sufficiently long to have recorded any breeding migrations as nesting in the Mediterranean commences in late May or early June and males arrive at breeding sites at least a month before nesting commence. None of the three turtles migrated to a breeding area. Four of the five transmitters deployed in 2021 lasted sufficient length of time (June 2022 or later) to cover breeding migrations of the turtles. Two of the four (including the re-tagged individual) migrated over 230 km to Kyparissia Bay in Greece, which currently hosts the largest nesting aggregation of loggerhead turtles in the Mediterranean. To summarise, if we conservatively omit the turtle with the 20cm tail as non-adult. One turtle migrated at the first potential breeding season, one turtle migrated after skipping a breeding season and four turtles did not migrate to breed at the first potential breeding season. Thus, we confirm that adult males do not all undertake annual breeding migrations. We also confirm links of male turtles to the Kyparissia Bay nesting area, for which we have existing connections of adult female turtles from flipper tagging and tracking. Three transmitters are still active at time of writing (October 2022) and we hope they might provide further insights into the breeding periodicity of male turtles from Amvrakikos in the coming season.

TRACKING NESTING TURTLES FROM KYPARISSIA BAY, GREECE, THE LARGEST LOGGERHEAD ROOKERY IN THE MEDITERRANEAN

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“Block 10”, an area offshore of Kyparissia Bay (Kyparissiakos Gulf) in western Greece, has been leased for hydrocarbon exploration. Part of the lease agreement includes biodiversity monitoring to minimise impacts on local marine fauna that may be present. Kyparissia Bay is known to now host the largest nesting aggregation of loggerhead turtles in the Mediterranean. However, relatively little is known on the whereabouts of the turtles both during and outside the breeding season, which are likely to at least in part overlap with Block 10. Most flipper tag recoveries of Kyparissia nesters come from the Adriatic Sea and the Gulf of Gabès (Tunisia), however the migratory routes and timings of movements to these areas remain unknown. We tracked eight nesting females, with the aim to identify internesting habitat, timing of post-nesting migrations, elucidate migratory routes, and describe the spatial and temporal intersection of turtle movements within the Block 10 area, thus aiding conservation. We deployed three Argos satellite transmitters to nesting turtles in 2021 and a further five transmitters in 2022. One transmitter from 2021 stopped functioning in Jan 2022, the other two remain active at time of writing (November 2022). Three of the transmitters from 2022 only lasted until July, August, and September 2022, and the remaining two remain active at time of writing. The lifespan of all the tags were sufficient to provide data to address all the project's aims. All eight turtles remained near to the nesting habitat during their breeding period and did not enter Block 10. Turtles departed the nesting area between 17 and 31 July the summer they were tagged. Two turtles migrated southwest to the Tunisian shelf. Four turtles migrated north-northwest two remaining within the Ionian Sea and two travelling further into the southern and northern Adriatic Sea. One turtle migrated east around the Greek mainland to set up residency in the northwest Aegean Sea and the remaining turtle has remained in the Ionian Sea, initially headed west, then north to Italian shores, followed by a return to Greek coast near the nesting area and finally headed west into oceanic waters mainly to the southeast of Sicily. Regarding the presence of turtles in Block 10 outside the breeding season, 4 turtles (50% of those tracked) passed through it. Two turtles (25%) migrated directly through the area, a further turtle (12.5%) briefly passed through a southern section and a final turtle (12.5%) passed through the area on departure from nesting and returned and pass through the area in December. There are likely to be over a thousand turtles seasonally present in Kyparissia Bay to breed and 50% of tracked turtles passed through Block 10, it is clear that hydrocarbon exploration during the breeding period would negatively impact the population. Therefore, at least for sea turtles, exploration should be carried out in the winter months. However, monitoring and mitigation measures should be established for the protection of turtles and marine life at all stages of exploration and exploitation, following international best practices, treaties, and agreements.

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*UNUSUAL BENTHIC EPIBIOTA OF GREEN TURTLES (*CHELONIA MYDAS*) AS INDICATOR OF BRUMATION IN URUGUAYAN COASTAL WATERS

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Uruguayan coastal waters are an all-year-round feeding and development area for juvenile green turtles (*Chelonia mydas*) in the Southwestern Atlantic. During winter, part of this turtle aggregation remains in coastal habitats. Furthermore, the carapace of overwintering turtles, may become an available substrate for benthic biota during cold months and could reflect the benthic assemblages of rocky shores in the area. The objectives of this study were to analyze the composition and structure of epibionts assemblages on juvenile turtles and to study the habitat use of overwintering green turtles in the Uruguayan coastal waters. To evaluate the presence of massive benthic epibiosis we analyzed the NGO Karumbe stranding´s database from 2008 to 2020 (n=1663). For each turtle, date, location, photographs and biometrics parameters were analyzed, and compared with turtles with and without epibionts. Secondly, to analyze the epibiosis assemblages we include only individuals registered from January 2019 to February 2020 (n= 340). For each turtle, presence/absence of benthic organisms on the carapace and coverage were recorded. Also, turtles were classified in four epibiosis states. The state of the carapace colonization was validated using a classification tree model (CART). Finally, similarities between the benthic assemblages settled on the rocks and on the turtle carapaces were compared using a multivariate non-metric multidimensional scaling (NMDS) technique. The mean sizes of the settled mussels on rocks and turtles were compared monthly using an ANOVA model. The occurrence of turtles with benthic epibionts changes seasonally, starting in August and reaching a peak during October and November between 2008 to 2020. No significant differences were found in carapace length between turtles with (n= 340) and without epibionts (n= 1049). Assemblages on turtle carapaces of mussels and foliose seaweeds are more similar than assemblages with barnacles, hydrozoans and filamentous seaweeds when compared with assemblages of rocks. Mytilus spp.? was recorded in all turtles with mussels, and their recruitment occurred at the same time as on rocks (September and October). Based on the sessile taxa recorded as epibionts and their distribution, it was possible to characterize the potential habitat of lethargic overwinter turtles. Such habitat was located from the shallow subtidal (less than 2 m) to 15 m deep, where beds of Mytilus spp.? are predominant with its associated biota. In turn, the mobile organisms associated with sandy or muddy substrates indicate the use of these environments near the rocky points in the area. This work continues the research developed by the NGO Karumbé, characterizing the aggregation of juvenile green turtles on the Uruguayan coast. Demonstrating the relevance of mussel assemblages and their associated biota as indicators of habitat use by green turtles in that area. Furthermore, the importance of continuing long-term monitoring and analysis of the occurrence of turtles with these epibionts was highlighted together with the climatic and oceanographic conditions to be able to predict future events of massive strandings and to be able to deepen the knowledge about the ecology of juvenile green turtles in this feeding and development area.

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*VARIATIONS IN DIVE BEHAVIOR AMONG TWO FORAGING GROUPS OF LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) MAY CORRESPOND WITH DIFFERENCES IN PREY DISTRIBUTION AND ENVIRONMENTAL CONDITIONS

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In the Northwest Atlantic Ocean, leatherback sea turtles (*Dermochelys coriacea*) partake in extensive migrations that lead them from tropical nesting beaches to foraging grounds in either the Gulf of Mexico or North Atlantic Ocean. Even though migrations to either of these regions differ greatly in distance, leatherbacks display similar remigration intervals, which may be attributed to differences in foraging behavior. To date, there has been limited information on the foraging behavior of leatherbacks along the U.S. continental shelf, especially along the Atlantic coast and in the Gulf of Mexico. We deployed archival satellite transmitters, capable of recording depth and temperature, on foraging leatherbacks in the Northeastern Gulf of Mexico (NGOM), off North Carolina, and off Southern New England (SNE). Foraging behavior was inferred based on a series of dive metrics synthesized from transmitter data including time at surface, shallow dives (>2 m & <10 m), deep dives (>10 m), and dives to the bottom. Leatherbacks foraging in the NGOM occupied the upper mixed layer occasionally diving below the thermocline, while leatherbacks off SNE utilized the entire water column. Based on these dive data, we inferred leatherbacks in the NGOM took advantage of prey accumulating along the thermocline and exhibited deep dives past this layer to thermoregulate given the relatively high sea surface temperatures of the Gulf. Comparatively, we inferred leatherbacks off SNE to forage throughout the entire water column as well-mixed waters may have evenly distributed prey vertically, while suitable temperatures eliminated the need for thermoregulatory behavior. By identifying these behaviors, we not only shed light on trade-offs associated with foraging in each area, but also use these behaviors to infer foraging in regions along the U.S. continental shelf that have been previously undocumented.

POPULATION STRUCTURE AND HEALTH STATUS OF HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*) IN BANCO CHINCHORRO BIOSPHERE RESERVE

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The Banco Chinchorro Biosphere Reserve (RBBCH), located in the southern Mexican Caribbean, is a false coral atoll used as a transition, protection and feeding site for sea turtles, however, the current situation of the populations of hawksbill turtles who temporarily inhabit this important site for their development, is unknow. During the years 2014, 2022 and 2023, population information of the hawksbill turtle (*Eretmochelys imbricata*) was obtained at the RBBCH. The turtles were captured through free diving, in collaboration with the fishermen during their daily fishing for lobster. Morphometric parameters were obtained, a general physical examination was performed, and a blood sample was taken. The frequency of sizes, distribution and abundance, as well as the basal blood values of the studied population were determined. The results showed that the hawksbill population was composed mostly of juvenile individuals, with an average size of 42.6±13 and a size range from 22 to 81 cm in curved carapace length. During the monitoring, 118 hawksbill turtles were captured and marked with a monel steel plate, with no records of recaptures. The month of July presented the highest number of turtle captures. The population of hawksbill turtles is reported as healthy, likewise, the ranges of hematological parameters of the hawksbill population were determined. Other species were occasionally captured, such as the green sea turtle (*Chelonia mydas*) 3 (10%) and the loggerhead sea turtle (*Caretta caretta*) 2 (3%) of the total capture record. A catch per unit effort (CPUE) it was 5.5 sea turtles per hour. Is recommended to continue monitoring the turtle populations in RBBCH, as well as their health status over time. Furthermore, it is important to identify the food resources for these species; All of the above will allow a better understanding of the movements and preferences of the turtles for conservation purposes of the site and its inhabitants.

THE FINE-SCALE HABITAT USE OF FORAGING GREEN TURTLES IN THE NORTHERN TERRITORY

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Despite their conservation status, the at-sea behaviour of green turtles (*Chelonia mydas*) in the Northern Territory remains insufficiently understood to support conservation management. Green turtles are listed as “vulnerable” and “migratory” under the Australian Commonwealth’s Environment Protection and Biodiversity Conservation (EPBC) Act 1999 and “Endangered” by the IUCN Red List of Threatened Species. Green turtles are also an important food resource for indigenous Australians and a species of cultural importance across many areas of the Top End. Working with indigenous ranger groups, this project aims to attach satellite tags to green turtles at foraging grounds across the Northern Territory and investigate

the relationship between their utilisation densities and the available foraging habitat. The movements of 12 adult foraging green turtles (8 males and 4 females) have been analysed to identify their foraging utilisation densities. Two of these male turtles (tagged foraging off Field Island, Kakadu National Park) underwent a return migration from Field Island to the northern Kimberley region of Western Australia and then returned to Field Island. The preliminary results of this study are presented here.

GREEN TURTLES DIET FROM THE PERSPECTIVE OF MACROALGAL MORPHO-FUNCTIONAL GROUPS

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Macroalgae are important sources of lipids, vitamins, minerals, amino acids, and other trace elements in continental and insular marine coastal ecosystems, and are frequently ingested by the green turtle (*Chelonia mydas*), which is one of the most frequent species of sea turtles in nearshore areas of the Southwestern Atlantic Ocean (SWAO). In addition to the nutritional benefits of macroalgae for *C. mydas*, there is reciprocal value of this consumer via its grazing activity, that may drive patterns of algal growth and biomass. Specifically along the Paraná coast, southern Brazil, macroalgae species richness is considered low compared to other tropical areas in the country, with around 130 taxa of green algae (Chlorophyta), red algae (Rhodophyta) and brown algae (Phaeophyceae); nevertheless, marine algae along rocky shores, as well as mangroves from these areas, are essential for primary production, and as foraging habitats. Macroalgae can be classified into morpho-functional groups, based on their shapes, thickness, and cell wall contents, as well as their differences in photosynthetic and carbon assimilation efficiency. Moreover, the same photosynthetic and bio-chemical pathways that determine classification, also lead to morphological differences that affect their consumption by herbivorous species. For example, most marine herbivores tend to forage on filamentous, foliose, or fleshy species, rather than on branched calcareous ones, that have rigid walls that are more resistant to predation. Across 10 years along the Paraná coast, 190 juvenile specimens of *C. mydas* were collected dead-stranded during beach monitoring efforts. They had their digestive tracts collected and prepared for dietary content analysis, focused on the taxonomical identification of macroalgae and their importance in *C. mydas* diet (the latter based on the index of relative importance (IRI) of each prey group). A total of 49 taxa were identified; the most important morpho-functional group was the foliose algae (IRI = 11.84), represented by the green alga *Ulva lactuca*, followed by the corticated terete algae (IRI = 0.36), represented by the red alga *Gracilaria domingensis*; and the thin leathery algae (IRI = 0.25), represented by the brown alga *Sargassum cymosum*. These morpho-functional group consumption differences may be explained by the carbohydrates content of each one, which tends to be higher in Chlorophyta and Rhodophyta, especially in *Ulva lactuca*, and the low fiber content of this macroalgae (28.4%) which makes the turtles' digestion easier and faster. Also, the high consumption of *Sargassum cymosum* may be explained by its large fronds and high lipid, oligoelement and carbohydrate (polyssacharide) contents. Green turtles exhibited two foraging behaviors: browsing and grazing. Whereas the browsers foraged on leathery macroalgae, the grazers foraged on algae turfs. Our results show that green turtles were mostly foraging on foliose macroalgae, displaying both foraging behaviors in the area, and, hence, using different foraging areas. This study provides a dataset of macroalgae species consumed by green turtles in the SWAO, focusing on their nutritional value and providing a baseline for further monitoring of C. mydas diet and foraging habitats. Thus, these data could support further studies aiming to delineate foraging grounds of high conservation value.

POST-NESTING MIGRATION OF THE GREEN TURTLE (*CHELONIA MYDAS*): ROUTES, MIGRATION STRATEGIES, AND FEEDING AREAS OF THE NESTING POPULATION OF COLOLA, MICHOACÁN, MEXICO

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Knowledge of spatial ecology is critical for marine species effective conservation. Green turtles *(Chelonia mydas)* in the Eastern Pacific (EP) are a Distinct Population Segment (DPS) and listed as threatened under the Endangered Species Act. The nesting population in Colola beach, Michoacán, México, is an essential nesting rookery in the entire region. Still, little is known of habitat use and migratory routes of green turtles during internesting and post-nesting periods. The aims of this study were to (1) identify post-nesting migratory routes used by green turtles departing Colola beach using satellite telemetry and (2) to compare their migratory corridors with existing spatial fishery data to elucidate areas of potential high fishery interactions. Twenty-three turtles were tagged [Wildlife Computers SPOT6, n = 3 (Redmond, WA, USA); Sirtrack 376D, n = 20 (Havelock North, Hawkes Bay, New Zealand)] after nesting, at Colola Beach, during the 2018-2019 and the 2020-2021 season. Twenty-three turtles were tagged with PTTs (Platform Transponder Transmitters) [Wildlife Computers SPOT6, n = 3 (Redmond, WA, USA); Lotek 376D, n = 20 (Havelock North, Hawkes Bay, New Zealand)] after nesting, at Colola Beach, Michoacán, (n=10) during the 2018-2019 season; (n=13) and the 2020-2021 season. Turtles were tracked using the Argos satellite system. Tracking duration ranged from 24 to 160 days (mean: 58 ± 27 days), and total travel distance ranged from 1 to 2,121 km (mean: 914 ± 433 km) (Table 3). Total transmissions per turtle ranged from 500 to 10,294 (mean: 2,976 ± 2,522). Travel speeds for migration movement (km day-1) ranged from 14.97 to 43.5 (mean: 26.28 ± 7.2) while foraging rates ranged from 2.52 to 12.8 (mean: 6.33 ± 3.62) (Table 4). The Migration Straightness Index or MSI ranged from 0.01 to 0.97 (mean: 0.51 ± 0.33). Fifteen of the 23 turtles tracked made a coastal migration south of the nesting beach; 3 turtles stayed in the area in front of the nesting beach; and the other five migrated northwards, two of which showed foraging behavior: turtle 101 in the insular complex of the Tres Marias Islands and turtle 115 in Sinaloa´s coastal lagoon systems. The data provided by this study will contribute to the effective conservation of the eastern Pacific green turtle DPS, the preservation of its habitat, and other associated species.

CONSUMPTION OF FISH AND SHRIMP BY KEMP'S RIDLEYS AND RELATIONSHIPS WITH NORTHERN GULF OF MEXICO FISHERY BYCATCH

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The Kemp's ridley sea turtle (*Lepidochelys kempii*) is native to the northwestern Atlantic Ocean and Gulf of Mexico and a focus for conservation efforts. Ridleys utilize coastal waters of the Gulf as developmental and adult foraging habitats. Although egg harvest and shrimp fishery regulations have been successfully implemented to conserve these animals, human interactions continue to affect the species. The natural Kemp's ridley diet consists predominantly of crabs and other benthic invertebrates. In addition, opportunistic scavenging on fishery discards has been documented in multiple areas of their range. To investigate geographic and size class trends in fish and penaeid shrimp consumption, we examined gut contents from 600 Kemp's ridleys that stranded in the northern Gulf of Mexico (NGOM), USA during 2011-2015; all turtles were subsequently necropsied. We examined archived diet subsamples, visually identifying prey to the lowest possible taxonomic level. We compiled publicly available bycatch data to examine relationships between diet results and fishery bycatch. Sampled turtles were organized into four geographical categories (Western Louisiana, Central Louisiana, Eastern Louisiana/Mississippi, and Alabama/Florida Panhandle) and three size classes (<25, 25-40, and >40 cm straight carapace length, SCL). Regional trends for shrimp and commonly-consumed bony fish species were compared to the National Bycatch Report and other publicly-available data to determine potential source fisheries and gear types within these locations. Overall, 80% of sampled Kemp's ridleys had consumed bony fish (Osteichthyes) and 6% had consumed penaeid shrimp. Central Louisiana trended higher for overall fish species diversity in Kemp's ridley diet and had the highest occurrence of shrimp among regions (12% of turtles). Atlantic croaker (Micropogonias undulatus), sea catfishes (Ariidae), and black drum (Pogonias cromis) were the most commonly consumed fish within all regions, with the highest Atlantic croaker occurrence in Central Louisiana (21%) and the highest catfish occurrence in Western Louisiana (57%). Smaller ridleys (<25cm SCL) were most likely to have consumed shrimp. Bycatch of sea turtles is known to occur in the US Gulf of Mexico shrimp trawl fishery, which is also a likely source of fish consumed by stranded ridleys, including Atlantic croaker, black drum, and sea catfish. Other sources of common and moderately consumed fish species may be attributed to other fisheries within this region and discards by recreational anglers. Our results highlight the relative importance of probable anthropogenic food sources in NGOM Kemp's ridley diet, particularly offshore of Louisiana. These high levels of fish consumption and modest occurrence of shrimp consumption are of concern, given the association with fisheries and risks to sea turtles, including boat and gear interactions. Research was conducted under Florida MTP-256 and a U.S. Fish and Wildlife transfer authorization letter, with in-kind support from the National Marine Fisheries Service.

*USING MINIMUM APPROACH DISTANCE TO QUANTIFY SIZE-MEDIATED SEA TURTLE RESPONSE BEHAVIOR AT ARTIFICIAL REEFS IN THE NORTHERN GULF OF MEXICO

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In-water behavioral studies of sea turtles, especially size-specific, have been previously limited due to difficulty of encountering and observing individuals in their natural habitat. However, Stereo-video cameras

(SVC) are a non-invasive in-water approach that allows researchers to collect size-specific data while also recording observations of relatively undisturbed sea turtle behavior. In this study, we performed SVC surveys at local artificial reefs, piers, and jetties in the northern Gulf of Mexico (nGOM) from May 2019 to August 2021. Using the SVC to remotely measure sea turtle straight carapace length, we quantified wariness to diver presence by assessing minimum approach distance (MAD) and documenting rare behaviors. Across our 16 dive sites, we had 107 unique encounters, 10 of these encounters did not allow for accurate straight carapace length (SCL) measurements. Of the 97 encounters in which SCL was measured, we observed 73 green, 16 loggerhead, and 8 Kemp's ridley sea turtles. The green sea turtles were primarily juveniles with 89 % (n = 65) considered juveniles, 8.2% (n = 6) considered subadults, and 2.7% (n = 2) considered adults. The overall mean SCL for greens was 48.33 cm ± 16.44 cm SD. Of the loggerhead sea turtles observed 62.5% (n = 10) were classified as subadults and 37.5% (n = 6) were considered adults, with a mean SCL 79.02 cm ± 12.19 cm SD, n=16. Of the Kemp's ridleys (SCL: 50.57 cm ± 6.85 cm SD, n=8) all were classified as subadults. Green sea turtles exhibited the largest range of MAD (0.72 – 5.99 m) before eliciting a startle response, while the range of MAD for loggerheads (range: 0.93 – 3.80 m) and Kemp's ridley's (range: 0.78 – 3.63 m) were similar to one another. Using a linear mixed model, we evaluated which parameters were most influential to MAD. Using the AICc-based model selection the size of the turtle, regardless of species, was the most influential variable. Our results suggest that larger individuals have a greater wariness response and are startled from greater distances than smaller individuals. Additionally, we recorded rarely observed behaviors, such as self-cleaning, symbiotic cleaning, and feeding. Loggerhead and green sea turtles were observed self-cleaning by resting underneath a substrate, such as a reef module or boulder, and rubbing their shell against the object. Further, we observed loggerheads participating in symbiotic fish cleaning, with fishes picking epibiotic organisms from their carapace, head, and flippers. Green sea turtles were also observed partaking in self-cleaning and simultaneously intraspecific behaviors, in particular two individuals competed over PVC pipe, as a cleaning substrate. Greens were also seen on multiple occasions feeding, while loggerheads and Kemp's ridleys were not observed participating in this behavior. This study supports the use of SVC as a generally accessible, non-invasive tool to conduct ecologically relevant in-water surveys of sea turtles that links behavioral observations to body size.

VALIDATING THE USE OF STEREO-VIDEO CAMERAS TO CONDUCT REMOTE MEASUREMENTS OF SEA TURTLES

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Numerous monitoring programs exist worldwide for sea turtles and these programs have collected valuable data that has both uncovered secrets about these animals' behavior and help guide conservation efforts. However, most sea turtle research programs require that individuals can either be captured by hand or are relatively accessible on nesting beaches. Furthermore, handling of these animals can cause undue stress and be time consuming in both the chase and work-up of the turtle. Thus, there is a need to develop methods for monitoring sea turtles remotely without the need for direct contact. Length measurement data is crucial to estimate cohort strength, somatic growth rates, age-at-maturity, and survival rates. To overcome the obstacles of hand-capturing sea turtles, we tested the use of a stereo-video camera system (SVCS), which allows for 3D measurement of morphometric data. SVCS are a non-invasive method to obtain length-based data as well as photo-identification photos. SVCS has been used for other marine organisms to determine body length, biomass, and abundance, but limited usage for sea turtles. The use of SVCS eliminates handling stress and can potentially improve the efficiency by which morphological data can be collected for wild sea turtle populations. For this, we validated the maximum straight carapace measurements obtained via the SVCS with measurements obtained with calipers. Sixty-three juvenile and subadult sea turtles across three species (*Caretta caretta* (n=8), *Chelonia mydas* (n=52), and *Lepidochelys kempii* (n=3)) were hand-captured using turtle rodeo techniques in the waters off Cape Eleuthera, Bahamas and Crystal River, Florida from May– August 2019. We completed a full work-up on all captured turtles, which included straight carapace length (SCL) and curved carapace length (CCL) measurements, tagging, and facial identification photos. When turtles were released back into the water, the turtle was recorded with the SVCS. In Eleuthera, the researcher swam briefly with the turtle to achieve different angles and orientations of the camera relative to the turtle to determine how camera angle influenced measurement accuracy. The video footage was analyzed in SeaGIS EventMeasure, where 10 measurements were taken for each turtle filmed. Manual SCL measurements (mSCL) ranged from 25.9 to 89.2 cm, while the extracted stereo measurements (eSCL) ranged from 24.7 to 91.4 cm. The mean percent bias of eSCL ranged from -0.61% (± -0.11 SE) to -4.46% (± -0.31 SE). The global average percent bias across all species was -0.99% (± -0.01 SE), indicating all eSCL measurements were slightly underestimating the manual SCL. Thus, SVCS measurements have a very small error with a slight negative bias. This new technology enhances field studies of sea turtle morphometrics while providing advantages such as the ability to archive and re-evaluate data, as well as, couple morphometrics with sea turtle behavior. The implications for SVCS for conservation management efforts are immense and show great promise at filling in critical knowledge gaps for many populations globally.

DISTRIBUTION OF GREEN TURTLES (*CHELONIA MYDAS*) IN THE AZORES: A LOCAL ECOLOGICAL KNOWLEDGE (LEK) APPROACH

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Effective conservation strategies for sea turtles require knowledge of species distribution across different life stages, especially during the juvenile oceanic stage when individuals disperse over wide areas of the open ocean. The green turtle (*Chelonia mydas*) is a cryptic species known to inhabit coastal waters of the Azores archipelago, and little is known about its presence and ecology in the region. This study used Local Ecological Knowledge (LEK) by conducting a questionnaire on the occurrence of green turtles in the Azores between August 2020 and April 2021. The questionnaire was divided in two sections: 1) description of the green turtle sighting and 2) interviewees' profile. The first section describes the sea turtle and its surroundings, while the second section describes the profile of the interviewee in order to evaluate its influence on the sighting. In total, 56 interviews were performed resulting in 69 green turtle sightings in the islands of Faial and Pico, and most sightings were reported by scuba divers and free divers. The results confirmed a regular presence of green turtles in the Azores. The description of estimated straight carapace length (SCL, mean = 35cm) confirmed that all green turtles in the region are most likely juveniles. Most sightings occurred nearshore, during the summer and autumn, close to rocky sea floor at around 8 meters deep. This study represents the first assessment of green turtles' occurrence in the Azores, and lay down the basis for future systematic and hypothesis-driven studies essential for the delineation of adequate management strategies for green turtles' conservation in the region.

ONE OF THE MAIN WINTERING AND FORAGING AREAS IN THE MEDITERRANEAN WAS IDENTIFIED AND ITS ASSOCIATION WITH TWO NESTING POPULATIONS DEMONSTRATED IN KÖYCEĞIZ-DALYAN SPECIAL ENVIRONMENTAL PROTECTION AREA, TURKEY

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It is important to determine the connectivity between the breeding and feeding areas of migratory species and the common areas used by different populations in order to take effective conservation measures in their habitats. Different methods are used to determine the connectivity of different species and their habitat use, among which stable isotope analysis (SIA) is widely used in ecological studies. SIA allows us to identify different areas used by many individuals with a relatively inexpensive method. Individuals with similar isotopic signatures are assumed to use common areas. Generally, when analyzing samples from individuals at nesting beaches, it is necessary to verify the predicted feeding areas of the individuals by different methods such as satellite tracking. However, satellite tracking can only be applied to a limited number of individuals and therefore it may be necessary to collect large numbers of samples from different areas. Another limitation encountered in SIA studies is the tissue type sampled. Various tissues can also be used in SIA studies, and researchers generally collect and store samples with an opportunistic approach. However, due to the different turnover rates of different tissues, it may not be appropriate to compare different tissues collected in the long term. While the number of studies with SIA is increasing in different parts of the world, studies on this subject from the Turkish coast, which has important sea turtle nesting beaches of the Mediterranean, are limited. In this study, we conducted research in Köyceğiz-Dalyan Special Environmental Protection Area (SEPA) in Türkiye, which includes both an important nesting beach and a wintering and feeding area for the loggerhead sea turtles (*Caretta caretta*). Our aim was to determine the $\delta^{13}C$ and $\delta^{15}N$ levels of the loggerhead sea turtles overwintering in Köyceğiz-Dalyan SEPA and to determine the contribution of different breeding populations from Dalyan and Belek nesting beaches to this wintering area. In addition, three different tissues; scute, erythrocyte and blood plasma, were examined and the differences between these tissues were investigated. Our results showed that individuals using Köyceğiz-Dalyan SEPA (n= 80) for overwintering have specific isotopic signatures, as well as showing that some of the females from both nesting populations (n= 53) use Köyceğiz-Dalyan SEAP as a wintering ground. Our results also showed that stable isotope values of scute and erythrocyte were almost identical, but stable isotope values of blood plasma were quite different. Thus, a specific wintering and feeding area in the Mediterranean was identified without satellite tracking studies. Our results also showed that most of the overwintering individuals did not migrate from the Köyceğiz-Dalyan SEPA, the region hosts individuals from different breeding populations in Türkiye, and some of the individuals overwintering in the same region also contribute to the nesting population.

SEX RATIOS IN JUVENILE HAWKSBILL AND GREEN SEA TURTLES CAPTURED IN ST. KITTS, WEST INDIES 2007-2021

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In species with temperature dependent sex determination such as sea turtles, increasing temperatures raise concerns regarding sex ratios and species survival. Previous studies in the Caribbean utilizing plasma testosterone assays to determine sex ratios in juvenile hawksbill sea turtles have documented female to male ratios ranging from 2.1:1 to 9.3:1 (Lèon and Diez 1999, Diez and van Dam 2003, Hawkes et al., 2013, Blanvillain et al., 2008, Geiss et al., 2016) and for juvenile green sea turtles in the Caribbean and Pacific, from 1.0:0.96 to 3.5:1 (Wibbels et al., 1989, Bolten et al., 1992, Wibbels et al., 1993, Allen et al., 2015). In St. Kitts, juvenile green and hawksbill sea turtles foraging in the nearshore waters are captured as a portion of the SKSTMN In Water Monitoring and Health Assessment Program. The nesting season for adult females of both species occurs from March to December with hatchlings emerging through February. This nesting partially coincides with the open harvest that runs from October 1 to February 28th. Studies examining hawksbill hatchlings in St. Kitts classified sex in 27 hatchlings that were found to include 25/27 (92.6%) females and 2/27 (7.4%) males (Rodríguez et al., 2022) but no current information is available on sex ratios in juvenile foraging aggregations in St. Kitts. For this study, 79 juvenile sea turtles (54 hawksbills, 25 greens) captured via snorkel in St. Kitts and six subadult to adult sea turtles at landing sites were sampled. A complete physical exam was performed. Untagged juvenile sea turtles were tagged (Eckert and Beggs 2006). Venipuncture was conducted at the dorsal cervical sinus. Sodium heparinized whole blood was centrifuged at 3,200RPM (VWR International, Radnor, PA, USA) for 10 minutes and plasma was separated. Plasma was placed in 0.5mL aliquots and stored frozen (-80°C). Testosterone concentrations were quantitated using a commercial enzyme immunoassay kit (EIA; Arbor Assay, K032-H1/H5; Ann Arbor, MI, USA) previously validated for use in turtles. Solvent extraction (diethyl ether) of pooled turtle plasma and subsequent serial dilutions or spiking extracts with testosterone reference standards resulted in parallelism with the reference standard curve and an average recovery of 96.2%. Intra- and inter-assay CVs were <5% and 14.7%, respectively, with a sensitivity of approximately 9.9 pg/mL. Based on testosterone concentrations previously established for juvenile hawksbills and greens, our study population demonstrated a 2.4:1 female to male ratio with two individuals falling within an unknown range. For greens we found a 1.4:1 female to male ratio with one individual falling within the unknown range. These data indicated that the female to male ratio in this population is not as highly female skewed as ratios reported in other areas. Data for hawksbills in this study are closely aligned with ratios outlined in Puerto Rico and the Dominican Republic (Lèon and Diez 1999, Diez and van Dam 2003) and for greens with ratios reported for the Bahamas (Bolten et al., 1992). When possible, sex ratio monitoring should be incorporated into health assessment programs for hatching and juvenile sea turtles to aid in decision making from a conservation management perspective.

*FEEDING INTERACTIONS BETWEEN HAWKSBILLS TURTLES AND REEF FISH IN SANDY BAY WEST END MARINE RESERVE, ROATÁN, HONDURAS

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Cheloniid turtles are often presented as flagship species for conservation efforts due to their charismatic nature as marine megafauna. However, the ecological impacts of their presence in the environment is not well understood. There are few studies on their ecological relationships with other species and most research, thus far, has focused on trophic interactions or on epibionts. In the Sandy Bay West End Marine Reserve (SBWEMR) off of the coast of Roatán, Honduras, the Protective Turtle Ecology Center for Training, Outreach, and Research Inc. (ProTECTOR, Inc.) has collected data on symbiotic feeding associations between juvenile hawksbill sea turtles (*Eretmochelys imbricata*) and reef fish from 2016 to 2022. Using SCUBA, we observed wild juvenile hawksbills within the SBWEMR, using both underwater video cameras and underwater paper to record feeding events and any fish associated with those events. A total of 48 feeding events was recorded on video, 24 of which were sponge-feeding, 21 algae-feeding, and 3 coral-feeding. An additional 48 feeding events were recorded without video: 32 of these were sponge-feeding events, 14 algae-feeding, and 2 coral-feeding. A total of 17 different fish species were recorded associating with turtles during feeding events, including 4 species of angelfish in the genera Holacanthus and Pomacanthus. We found that angelfish associated with turtles 99.9% of the recorded video time during sponge-feeding events, while only associating with turtles for 7.6% of algae-feeding events and 0% of coral-feeding events. Meanwhile, other fish species associated with turtles for 95.4% of sponge-feeding events, 20.2% of algae-feeding events, and 89.4% of coral-feeding events. We find that fish associated with turtles significantly more often during sponge-feeding events than either algae- or coral-feeding; this was true for both angelfish and non-angelfish species, although the relationship was much stronger for angelfish. Spongivorous fish may benefit from associating with turtles due to the turtles' ability to cut through the sponges' tough pinacocyte layer, allowing the fish to access the softer tissues inside the sponge, while turtles may benefit from the association by being led to orient to sponges by fishes aggregating near sponge species turtles seek out for feeding.

*CONNECTIVITY BETWEEN REEF AND MANGROVE HABITATS OF HAWKSBILL SEA TURTLES IN A TROPICAL UPWELLING REGION FROM THE EASTER TROPICAL PACIFIC

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Understanding where animals go and what drives their movement patterns is crucial for implementing effective spatial management approaches. This is particularly true for threatened and wide-ranging species like sea turtles, where knowledge of how they use critical habitats (e.g., reproductive grounds, feeding areas, migratory routes, etc.) is crucial for conservation planning and to ensure recovery of their populations. This study quantified the movement and residency patterns of hawksbill sea turtles (*Eretmochelys imbricata*) in Matapalito Bay, a small, protected bay in the north Pacific of Costa Rica that is under the influence of seasonal coastal upwellings from December to April, which has been identified as an important feeding ground for the Eastern Tropical Pacific (ETP) population. Twelve individuals were tagged and monitored with acoustic transmitters between 215 and 695 days. Residency index (RI) to Matapalito varied between 0.0 and 0.37 (RI: 0.10 ± 0.12). Of all tagged individuals, 67% moved to the nearby Santa Elena Bay, to other reef and mangrove habitats, and travelling up to 4 km. The movement patterns shown could be being affected by the environmental conditions caused by the seasonal upwelling, such as low temperatures or high productivity during the upwelling months. The low residency in our study area suggest that Matapalito Bay may represent just a small portion of the entire area used by this population to fulfill their biological requirements. On the other hand, the variable movement behaviors between different habitats support the plasticity hawksbill turtles in the Eastern Tropical Pacific have shown before and could indicate these turtles are moving longer distances between habitats to find food and shelter. These results highlight important knowledge gaps that should be explored and considered in future spatial planning of the region for the recovery of this population.

TRACKING EARLY-STAGE JUVENILE LOGGERHEAD SEA TURTLES IN THE NORTH-EAST ATLANTIC OCEAN

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The oceanic juvenile stage remains one of the most enigmatic life stages of loggerhead sea turtles (*Caretta caretta*). The dispersal, oceanic habitat and movements of the youngest age classes in particular remain poorly known. After hatching, these small sea turtles disperse over vast oceanic areas only to return to neritic areas many years later, a period often referred to as the “lost years”. The Azores is an oceanic archipelago in the central North-East Atlantic, and one of the few places where all juvenile age-classes of

oceanic juvenile loggerheads can be found, from young-of-the-year to late oceanic juveniles, with sizes ranging from 7.8 – 82 cm CCL. To investigate the movements of early juveniles, we equipped 30 small loggerheads measuring between 13.8 and 33.2 cm CCL (mean 19.6 ± SD cm CCL) with novel miniature Argos satellite tags (Lotek). All of the turtles, with one exception, were wild caught, by hand or with dip nets. One turtle was found stranded on the beach and rehabilitated at the Aquário do Porto Pim (Horta, Faial, Portugal). The turtles were released in 4 separate batches between November 2021 and June 2022. Days at liberty ranged from 8 to 188 days (mean: 63.5 ± 38.1 SD days). We will present the first results of this tracking experiment and discuss the movements, behaviour and habitat use of the turtles in relation to oceanographic features, such as sea surface temperature, productivity and ocean currents. This study is an important step towards a better understanding of their pelagic ecology and habitat in the open ocean in support of their conservation.

*ESTIMATING SCUTE GROWTH RATES USING RADIOCARBON ANALYSIS

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Scute is keratinized epidermis that grows from the basal epidermis and accumulates over time. It is metabolically inert and can be examined via stable isotope analysis to explore diet and habitat utilization. Currently, scute growth estimation is based on scaling carbon incorporation rates of juveniles to represent slow-growing adults. Radiocarbon has been increasingly used to provide age estimates for modern samples including coral skeletons, fish otoliths, and vertebrate eye lenses. Nuclear bomb testing in the 1950s and 1960s approximately doubled atmospheric ^{14}C, inadvertently providing scientists with a useful tracer in long-lived biota. This study uses radiocarbon to estimate scute growth rate in loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles. First, we validated radiocarbon aging techniques using eye lenses from deceased hatchling sea turtles of known years. Radiocarbon techniques have been applied to otolith and eye lens cores to validate age estimates in bony fishes. We measured loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtle eye lens $\Delta^{14}C$ ratios from hatchlings collected between 2019-2021 and one hatchling from 1992. Hatchling sea turtle $\Delta^{14}C$ values decreased annually, as expected. A majority of the individual and the annual mean hatchling eye lens $\Delta^{14}C$ values fall within the predicted values of a regional $\Delta^{14}C$ coral and known-age otolith reference series. Next, we applied radiocarbon aging to scute records. Scute biopsy samples (6 mm diameter) were collected from non-hatchling sea turtles, sub-sectioned into 50-µm layers, and analyzed for $D^{14}C$ composition to estimate the growth year of each layer. Overall, $\Delta^{14}C$ values declined over time. While the individual scute growth rates varied among turtles, the mean time period represented in 50-µm increments was consistent with previously published estimates. However, while radiocarbon is useful to confirm or estimate age in other long-lived organisms, such as corals, fish, and trees, we conclude it may be too coarse to provide accurate temporal resolution at such a fine scale as estimating scute growth rates.

*SHOULD I STAY OR SHOULD I GO? ENVIRONMENTAL DRIVERS OF RESIDENCE AND OUTWARD TRANSIT DURING FORAGING

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Foraging animals move through their environment to satisfy their requirements for food, rest, and risk-avoidance. For management of marine turtles, habitat use in foraging areas is an identified knowledge gap.

Understanding how turtles respond to changing conditions can help to characterise favourable habitat and determine whether turtles might be motivated to depart from their resident areas when they become unsuitable, potentially traversing high risk environments such as human dominated seascapes. In general, green turtles have high fidelity to foraging areas, and scarcely move in response to changes or disturbances. At our study site, green turtles persist through prolonged periods of reduced food availability, demonstrated by high rates of capture of emaciated animals. Some individuals though, sequentially exploit multiple areas, demonstrating a possible capacity to adapt to changes in the distribution and composition of available food resources. This study aims to determine what environmental conditions prompt a turtle to stay in their resident locations, or transit away from them. We examine movements of 83 green turtles that were tracked with highly accurate Fastloc GPS in a human-dominated, inshore foraging ground. We append values of bathymetry, temperature, turbidity, salinity, and speed of tidal currents to the tracks. These predictors were selected by expert elicitation, and with consideration of the dominant hydrodynamic processes at the site; a large tidal range and primarily tidal currents, a history of extreme floods delivering sediment and freshwater runoff, and frequent resuspension of sediment, impacting proliferation of primary producers. Turtle tracks are separated into two behavioural modes using the residence time method with Lavielle partitioning in the R package adehabitatLT. We distinguish between area restricted search behaviour (ARS; foraging or rest), with relatively high residence time compared to transitory behaviour. For every bout of ARS, we calculate the mean and variance of the predictors and use time-to-event analysis to assess the relative importance of these in influencing the duration of the ARS bout. Separately, we examine which of the predictors influences the initiation of outward transit by comparing the last location in each ARS bout – the point of 'outward transit', to the return to foraging (ARS) in the next bout. We apply kernel density estimates to the partitioned tracks to spatially differentiate between ARS vs transitory areas. This distinction may be useful from a management perspective to delineate where particular initiatives could be enforced to specifically target foraging habitat. Residence time was highest in water shallower than 12m, and in temperatures between 20ºC and 28ºC, and was significantly affected by Secchi depth and salinity. There were a diversity of strategies exhibited by individual turtles. Several tracks showed fine scale movements that were closely associated with tide regimes in intertidal areas. Small turtles may be able to exploit mangrove edges and shallow seagrass flats, while larger turtles need to move into deeper channels on a receding tide. Additionally, we hypothesise that having a diversity of strategies might improve the populations' resilience to dynamic conditions, such as changes to primary producer communities arising from sediment resuspension processes.

SATELLITE TRACKING REVEALS CRITICAL HABITATS AND MIGRATION ROUTES FOR GREEN AND HAWKSBILL TURTLES NESTING IN MONTSERRAT, EASTERN CARIBBEAN

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Satellite telemetry has been a fundamental tool in improving our understanding of sea turtle ecology and has enabled researchers to identify critical habitats used across multiple life stages in these highly migratory species. Knowledge of the distribution of habitats such as nesting beaches, interesting areas, migration corridors and foraging grounds is essential for informing conservation planning; but is lacking for many populations. The Eastern Caribbean island of Montserrat, for example, is a regionally important rookery for both green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles, yet very little is known about the spatial ecology of turtles nesting on the island. To address this, we tracked nine adult female green turtles and one adult female hawksbill turtle nesting in Montserrat using high-resolution GPS satellite tags over an 8–12-month period and used a behaviour switching state-space model to identify key inter-nesting areas, migratory routes, and foraging grounds. Turtle movements were also analysed in relation to current Marine Protected Areas and political boundaries. Analyses revealed four key inter-nesting hotspots along the western coast of Montserrat adjacent to key nesting beaches. Inter-nesting home ranges (95% utilisation distributions) and core use areas (50% utilisation distributions) varied between 0.68 – 22.13 km2 (mean = 8.29 km2) and 0.05 – 2.47 km2 (mean = 0.95 km2), respectively. Eight green turtles performed post-nesting migrations to foraging grounds in Antigua (n = 2), Barbuda (n = 2), US Virgin Islands (n = 2), Puerto Rico (n = 1) and Dominican Republic (n = 1). The tagged hawksbill turtle also performed a post-nesting migration to a foraging ground in Guadeloupe. Turtles migrated distances from 45.70 to 1013.61 km (mean = 297.83 km2) travelling at speeds ranging from 1.59 to 3.45 km h-1 (mean = 2.83 h-1). During migrations, turtles transited 2 – 7 national Exclusive Economic Zones (mean = 4) and 0 – 5 (mean = 2) Marine Protected Areas. Foraging ground home ranges and core use areas varied between 1.19 – 25.06 km2 (mean = 8.96 km2) and 0.19 – 4.40 km2 (mean = 1.61 km2), respectively, and in the case of green turtles, coincided with coastal seagrass meadows identified in remotely-sensed regional habitat maps. This study provides the first comprehensive investigation into the spatial ecology of adult female turtles nesting in Montserrat and delivers important information on the location of critical habitats which can inform future marine conservation planning, both locally and throughout the Wider Caribbean region. The high level of migratory connectivity exhibited by tracked turtles emphasises need for coordinated regional strategies to protect these highly mobile species.

ASSESSING VARIATION IN FORAGING ECOLOGY OF OLIVE RIDLEYS (*LEPIDOCHELYS OLIVACEA*) NESTING IN GHANA USING STABLE ISOTOPE ANALYSIS

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Olive ridleys (*Lepidochelys olivacea*) are the most common sea turtle found nesting in Ghana, and the west and central African coasts host much of the total olive ridley nesting in the Atlantic Ocean. However, there are still few published studies about their life history, ecology, and foraging habits in this region, and attempts at satellite telemetry have been minimally successful. Alternate methods to tracking such as stable isotope analysis are becoming more popular to assess foraging locations, as combined satellite tracking and isotope studies have shown that isotopic concentrations can accurately describe and predict the different foraging grounds of sea turtles across ocean basins. This study looks at the $\delta^{13}C$ and $\delta^{15}N$ ratios of tissue samples in 50 nesting female olive ridleys, collected while they were laying eggs at Mankoadze and Anloga beaches in Ghana between 2017 - 2020. While $\delta^{13}C$ values were similar between beaches, a higher average $\delta^{15}N$ value was seen in Mankoadze, especially in 2019. Small overlap of isotopic niches between beaches in 2019 indicates that there may be variation in foraging ecology of these sea turtles, although it cannot be determined if it is due to differences in diet or differences in foraging location. This supports a previous study that found higher than expected genetic differences between individuals at similar sites, suggesting that the females nesting at these beaches may come from different breeding and/or foraging grounds. Overall, this study helps provide background information for future studies regarding foraging ecology and variation between individuals in this area, which will be useful for population and conservation management strategies.

MOVEMENTS, HOME RANGES, AND HABITAT USE OF JUVENILE GREEN TURTLES IN SANTA ELENA BAY, MATAPALITO BAY, AND LEONCILLOS BAY IN COSTA RICA

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This study explores the movements, home ranges, and habitat use of juvenile green turtles (*Chelonia mydas*) in Santa Elena Bay (SE), Matapalito Bay (MP), and Leoncillos Bay (LC) in Costa Rica. We installed Innovasea (VEMCO V16) coded acoustic transmitters on 15 juvenile green turtles (curved carapace length mean±sd: 59.97±9.62 cm) identified using metal flipper tags and passive integrated transponder (PIT) tags. Acoustic transmitters relay information to receivers deployed in the environment. For this, we used 12 Innovasea (4 VR2w and 8 VR2Tx) acoustic receivers placed in the study bays such that they provided coverage of a variety of habitats including sandy areas, coral reef patches, rocky reefs, and mangroves. The 4 VR2w and 3 of 8 VR2Tx receivers were placed in SE in different habitat areas. 4 of the VR2Tx receivers were placed in MP to cover different habitat areas and were about 700 meters from each other. 1 of the VR2Tx receiver was placed in LC. The receivers recorded dates, times, and transmitter numbers whenever a tagged turtle was within about 350 meters of it. We acquired data on daily and seasonal movements of turtles and determined that they use these bays for foraging and resting (daily and seasonal). We also investigated their interaction with the inshore habitats located in this region. We observed differences in the daily and seasonal movements of the 15 juvenile green turtles. According to the results, we calculated the locations and sizes of home ranges for the 15 juveniles. We also provided 1) correlations between the home ranges, water temperature, and the relationship to their body sizes; 2) insights on the use of the available habitats. By expanding our knowledge about juvenile green turtles and their interaction with habitats in those bays, we can help update local conservation strategies and better preserve endangered sea turtles along all of the northern bays of Costa Rica.

NESTING BIOLOGY (ECOLOGY, BEHAVIOR, AND REPRODUCTIVE SUCCESS)

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*BETWEEN THE ATOLLS - A SUMMARY OF SEA TURTLE NESTING IN THE MALDIVES FROM 2018-2022

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Sea turtles are a vital part of the marine ecosystem in the Maldives. While five species have been recorded in the country, only two can be found in relevant numbers, the hawksbill and the green turtle. Historically, both species have been recorded to nest throughout the country, but consistent long-term nesting data is not available. In this study we present cumulative data from of nest monitoring from 2018 to 2022, including ad hoc reports from citizen scientists and marine biologists, as well as targeted monitoring initiatives, with the aim of providing a first comprehensive multi-season dataset on sea turtle nesting activity in the Maldives. During targeted monitoring, nests and false crawls were recorded with GPS location, species, track width, and - if possible - ID photographs of the nesting female. Nests were monitored until hatching and excavated two days later to document hatching success, developmental status of embryos and potential reasons for egg failure. We recorded nesting information from both species from islands in eight atolls throughout the country. The majority of the nests reported with 600 out of 656 are green sea turtle nests. Nesting in the Maldives occurs year-round, with a peak in overall nesting during the south-west monsoon season from June to September. However, nesting seasonality varies between atolls, as well as between the calendar years. Consistent datasets were collected from selected islands in Lhaviyani and Laamu atoll, allowing for a more in-depth analysis of the recorded green turtle nests including temporal and spatial distribution of nesting activity, incubation times, and hatching success rates. Between 2018 and 2022, 341 nests and 174 false crawls were recorded from these atolls. Overall median hatching success rate was high with 84.59% (SD = 26.81) and incubation lasted between 46 and 70 days (median: 59 days, SD = 4.44). Nest inundation and poaching were identified as the main threats to sea turtle nests in the country. Incidents of egg predation as well as obvious congenital malformations of embryos were an exception, only found in <1% of eggs examined during excavations. The findings of this study help inform conservation priorities and strategies for sea turtles in the Maldives, such as feasible nesting beach protection measures, and highlight again the importance of long-term monitoring projects.

*ALL EGGS IN ONE POOR QUALITY BASKET: ASSESSING HAWAIIAN GREEN SEA TURTLE (HONU) RESILIENCE IN LIGHT OF CLIMATE CHANGE IMPACTS

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The Hawaiian green sea turtle, or honu, primarily reproduces at one small (93 km^2) and remote atoll known as Lalo (French Frigate Shoals). Historical evidence suggests most (96%) honu make a reproductive migration (~700 km) from the main Hawaiian Islands (MHI) to Lalo to nest and bask on multiple islets within the atoll. Lalo is low-lying (e.g., <2 m above sea level), making it particularly susceptible to climate impacts. From 1963 to 2004, the size of islets within the atoll decreased from a combined total of 41.7 to 15.1 hectares. Subsequently, in 2018, two critical nesting islets were lost due to natural erosion (Trig Island) and a hurricane (East Island). Prior to its destruction, East Island hosted ~50% of annual nesting honu (maximum 880 nesting females/year), and while it has since re-accreted substantially (1.4 hectares), preliminary evidence suggests the "new" habitat is of much lower quality due to the island's lower elevation and dynamic nature as well as the observation of washed-out nests. Combined with the sea level rise and increased storm severity associated with ongoing climate change, there is concern that East Island will not be viable nesting habitat in the future. Tern Island is the largest islet (10.3 hectares) and represents one of the only remaining reliable landmasses for egg incubation where nesting habitat is not dynamic throughout the season. To assess the resilience of honu to the drastic change of their primary nesting beach, a plan was hatched to determine whether females would continue to seek out East Island and lay their eggs in one (poor quality) 'basket' or seek to lay eggs elsewhere within the atoll. This was accomplished via two tactics. Firstly, adult females that previously nested on East Island were captured while basking on beaches within the MHI, and their reproductive status was assessed via (1) a portable ultrasound device to visualize ovarian follicles and (2) blood total solids/protein and testosterone concentration. In 2021 and 2022, four females were satellite tagged prior to their reproductive migration from the MHI. Secondly, eight females that previously nested on East Island were satellite tagged while basking on East Island prior to the peak of the nesting season to assess nesting beach fidelity after arriving at Lalo. Out of the 12 satellite tagged females, two only used East Island, six used both East Island and other islets (including Tern Island), while four turtles used both East Island and other islets (excluding Tern Island) to bask and nest. These findings suggest honu are capable of using multiple nesting habitats and provide hope for honu resiliency to the ongoing habitat impacts in Lalo. Nonetheless, the long-term stability and quality of the available nesting habitat in Lalo remains unclear and raises important management concerns. Given this context, our unique study has significant implications for the conservation of this threatened green sea turtle population and is relevant for other sea turtle populations facing similar threats.

*THERMAL MONITORING IN BOAVISTA ISLAND, CABO VERDE WEST AFRICA

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Sea turtles are extremely susceptible to climate warming because many of their life history traits, including sex determination, correlate with temperature. The expected increase in temperature may result in highly feminized populations as well as increased the embryonic mortality. In this context, nest site selection is particularly relevant. Focusing on the largest nesting group of the Cabo Verde aggregation found in Boa Vista Island, we evaluated how tides, sand type as well as variations in temperature within and among nesting seasons correlated with incubation duration and nest success of loggerhead turtles. Sand temperature was recorded at 24 sites around the Boa Vista Island, from August 2018 to November 2021, with 2 datalogger per site ranging from the rear of the beach (near the vegetation, dunes, etc.) to the tide line. In general, sand temperature tended to show seasonal variation, were significantly different between months, reaching a minimum of 26.9°C in June and a maximum of 29,4 °C in September (Kruskal-Wallis x2 = 7030.5, p< 2.2e-16). Both curves show a seasonal variation when all the sex ratio data for Boa Vista Island are combined with the average nesting frequency data for four years (2018-2021). Showing a higher percentage of females during the months with the highest temperatures (August, September and October). Since this study represented the highest seasons, agreeing to another Tanner study hypothesis, if proportion of nests increases the sex ratio bias would be less skewed toward females. It is important to note that some nesting beaches produce males and offer some protection from potential climatic change. Anthropogenic actions could change the thermal conditions of these beaches and affect the breeding environment should be avoided.

EFFECTS OF HURRICANES ON OLIVE RIDLEY'S DEVELOPMENT AND EMBRYONIC MORTALITY

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Hurricanes affect the embryonic development of sea turtles as they can cause excess substrate humidity or nests flooding. Hurricane's season in the Mexican Pacific (May to November) overlaps with the *Lepidochelys olivacea* nesting season (August to January). Therefore, our objective is to evaluate the effects of these climatic events on incubation temperature, hatching success and hatchling malformations. In 2021, the impact of Nora and Olaf hurricanes at San Luis de la Loma, Guerrero, Mexico, was severe. The hatchery was flooded and endured constant rain for days, which affected 500 nests. 8 of nest affected did have a datalogger inside evaluating the incubation temperature. We obtained a 2.05% of hatching

success and 0% emergence success. The nests were incubated at 33.99±2.12 ˚C with a minimum of 26.68 ˚C and a maximum of 37.38 ˚C. During incubation, the nests were exposed to temperatures greater than 35 ˚C for 14 to 16 consecutive days. These temperatures are outside of the thermal tolerance of this species, and consequently, we observed 20 malformations amongst the hatchlings or embryos, which affected: 50% in head, 18% in carapace, 4.55% in plastron, 4.55% in cloaca, 22.73% in whole body. Leucism was shown on 41.79% of the hatchlings, which was usually in tandem with the presence of a malformation. Fifty-one variations in scute pattern were found; of those, 86.27% of them were asymmetrical. Environmental stress may also lead to abnormal development during the incubation period which can result in different malformations.

ST. THOMAS BEACHES MAY BE CRITICAL MALE-PRODUCING HABITAT FOR HAWKSBILLS IN THE UNITED STATES VIRGIN ISLANDS

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There are three sea turtle species commonly found nesting in the United States Virgin Islands (USVI): the green (*Chelonia mydas*), the leatherback (*Dermochelys coriacea*), and the hawksbill sea turtle (*Eretmochelys imbricata*). While regular survey efforts for sea turtle nesting activity occur on St. Croix and St. John, St. Thomas still needs a consistent monitoring program to determine the extent to which their beaches are used as nesting habitats. This study focused on monitoring sea turtle nesting activity on St. Thomas in 2021 and 2022 and identified four important nesting beaches on St. Thomas (Abi Beach, Caret Bay, Hendriks Bay, and Neltjeberg Beach). A total of 15 hawksbill nests and one green nest were laid during the 2021 nesting season, and two hawksbill and six leatherback nests were laid during the 2022 nesting season. We investigated the temperature profiles of five hawksbill nests laid on St. Thomas and 22 nests laid at the Sandy Point National Wildlife Refuge (SPNWR) on St. Croix during the 2021 nesting season using Hobo pendant data loggers to estimate hatchling sex ratios. The sand temperatures on different beaches in sections with and without canopy cover was measured to investigate the potential hatchling sex ratios produced on the two islands and if the location was influencing sand temperatures. Of the five nests on St. Thomas with data loggers between August and October 2021, two nests were estimated to produce 100% female hatchlings, and one nest was estimated to produce 100% male hatchlings. Of the two remaining nests, one was predicted to produce mostly males, and the other was predicted to produce mostly females, but these nests did not produce hatchlings for unknown reasons. Nests laid on SPNWR that had data loggers between August and October 2021 were all estimated to have produced 100% females. There was a significant difference between the shaded sand and unshaded sand at most beaches on St. Thomas and SPNWR, with the shaded sand showing cooler temperatures than the unshaded sand. St. Thomas beaches showed a peak sand temperature of 33℃ at the end of August 2021 in unshaded sand and a low temperature of 24℃ in January 2022 in shaded sand. The beaches at SPNWR had a peak temperature of 33℃ in the unshaded sand in August 2021, while the lowest temperature recorded was 28℃ in December 2021 in shaded sand. The data from this study suggests that St. Thomas beaches are suitable habitats for all three species found nesting in the USVI and may be critical male-producing beaches for hawksbill turtles.

FIRST EVALUATION OF CONGENITAL MALFORMATION RATES IN SEA TURTLE EMBRYOS AND HATCHLINGS IN THE CAYMAN ISLANDS, WESTERN CARIBBEAN

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Congenital malformations (CM) in sea turtles are scarcely reported. However, they often lead to embryonic mortality and their impact at the population level is not well understood. Previous research has suggested that CMs originate from a complex interplay between genetic and environmental factors. We present results from the first evaluation of external CM in loggerhead and green sea turtle embryos and hatchlings in the Cayman Islands. During the 2022 nesting season, we excavated 112 loggerhead turtle (*Caretta caretta*) and 102 green turtles (*Chelonia mydas*) *in situ* nests. Excavations were carried out 3 days after the natural hatch and number of hatched eggs, live and dead hatchlings, unhatched eggs with (EED) or without (EWED) embryonic development were recorded. Malformed organisms (embryos or hatchlings) were collected and their CMs recorded to calculate nest and egg prevalence (NP and EP) and severity per nest and per organism (SN and SO) indices. In loggerhead turtle nests, a total of 38 types of CMs were found, with NP = 48.2%, EP = 0.7%, SN= 1.7 (± 1.2) malformed organisms/nest, and SO =12.0 (±1.7) malformations/malformed organism. For green turtles, a total of 39 types of CMs were found, with NP = 44.1%, EP = 1.0%, SN = 2.4 (± 2.1) malformed organisms/nest, and SO =1.8 (±1.6) malformations/malformed organism. SN, SO and EP were not statistically different between species. For both species, the carapace region showed the highest number of malformation (53.8% and 63.6% of all CMs in loggerhead and green turtles respectively), followed by the craniofacial region (23.9% and 18.2% of all CMs in loggerhead and green turtles respectively). The most abundant CM in loggerhead turtles was supernumerary scutes (relative abundance RA = 58.1%), followed by micromelia (RA =12.9%); the most prevalent CM in green turtles was the presence of supernumerary scutes (68.7%), followed by leucism (13.0%). Hatching success was significantly lower for green turtle nests with malformed embryos (HSM= 78.9%) than normal nests (HSN= 86.1%; p = 0.02), but not for loggerhead turtles (HSM= 77.3%, HSN= 79.9%, p=0.2). This is the first assessment of congenital malformations in embryos and hatchlings of sea turtles in the Cayman Islands and provides information for future investigation on the possible aetiology of CMs and potential conservation measures to be taken.

INFLUENCE OF THE MARINE TURTLES' NESTING ENVIRONMENT ON THE CLUTCH SIZE AND THE DEPTH OF THE INCUBATION CHAMBER

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The increase in global temperature can affect the development of sea turtle embryos. Among the effects is the feminization of their populations, decrease in hatching and emergence success, increase in the frequency of supernumerary shields and decrease in the physical fitness of the offspring. Many factors such as the type of sand, the depth of the incubation chamber and the clutch size influence the incubation temperature. The female's ability to match nest characteristics to environmental conditions may influence hatchling survival and may provide a mechanism by which animals can keep pace with climate change. That is why we intended to evaluate some factors that influence the variation in the clutch size and in the depth of the incubation chamber in the Guanahacabibes Peninsula, Cuba. An increase in the clutch size was

found with the size of the female $r = 0.69$; $p < 0.05$. However, this variable was not related to the distance to the high tide line $r = -0.14$; $p = 0.46$, nor did it show differences between the different areas of the beach $H (2; 41) = 0.5318$; $p = 0.766$. No differences were found in this variable either between the number of re-nestings $F (2.16) = 0.33$; $p= 0.73$. The environment during nesting appears to influence clutch size. Relative humidity did not show a relationship with the number of eggs $r = 0.04$; $p = 0.88$. However, a positive correlation was found between ambient temperature $r = 0.58$; $p = 0.004$ and heat index $r=0.51$; $p<0.05$ with the number of eggs. The depth of the incubation chamber increased with distance from the high tide line $r = 0.43$; $p < 0.05$ and with ambient temperature during laying $r = 0.56$; $p<0.05$.

ENVIRONMENTAL AND NEST VARIABLES ASSOCIATED WITH ATLANTIC LEATHERBACK SEA TURTLE (*DERMOCHELYS CORIACEA*) EMBRYONIC AND HATCHING SUCCESS RATES IN GRENADA, WEST INDIES

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Annual monitoring of leatherback sea turtle *(Dermochelys coriacea)* nesting grounds in Grenada, WestIndies has identified low hatch rates compared to the worldwide trends. This study investigated the impact of select environmental variables on leatherback sea turtle embryonic development and hatching success rates on Levera Beach in Grenada between 2015-2019. The mean number of nests per year and eggs per nest were 667.6 ± 361.6 and 80.7 ± 23.0 sd, respectively. Within excavated nests, 35.6% ± 22.0 sd of eggs successfully developed embryos and 30.6% ± 22.6 sd of eggs successfully hatched. The number of eggs per nest and their embryo and hatching success rates varied between nesting seasons. Embryo development rate was associated with the nest position on the beach and both embryo development and hatching success were positively associated with nest depth and negatively associated with the percentage of eggs with microbial growth on the surface and the presence of inspissated yolk. There was no found association with month of the nesting season, distance from the high-water mark, distance from vegetation, nor maternal curved carapace length. The mean nest temperature was 31.7°C ±1.64 sd and temperatures during the middle third of egg incubation suggest highly skewed female sex ratios. Histopathologic findings in hatchling mortalities included severe, acute, multifocal, heterophilic bronchopneumonia with intralesional bacteria in 4/50 (8%) hatchlings. Data from this study guides conservation strategies and identifies risk factors and further avenues of research to support reproductive success of leatherback turtles in Grenada and the larger Caribbean region.

*LEATHERBACK TURTLES IN GRENADA, WEST INDIES: A TWENTY-YEAR SUMMARY OF RESULTS 2002-2022

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Grenada hosts a critical population of nesting leatherbacks sea turtles (*Dermochelys coriacea*), in the Caribbean region. In 2022, Ocean Spirits, a local non-profit NGO, conducted their 23rd consecutive year of nesting research with local staff supported by international volunteers on Levera beach on the north-eastern tip of the main island. The International Union for the Conservation of Nature (IUCN) Red List status of leatherback sea turtles is 'Vulnerable'. However, in 2019, IUCN reclassified the Northwest Atlantic leatherback sea turtle subpopulation as 'Endangered'. Fisheries by-catch poses the greatest global threat but in Grenada leatherback sea turtles face other threats including illegal egg harvest, beach erosion and coastal development. Leatherback sea turtles have been protected by national legislation in Grenada since 2001, however a legal fishery still exists for hard-shelled species during seven months of the year (1st September to 31st March). Ocean Spirits data shows nesting numbers are declining with just 181 confirmed nests being laid by only 63 individual leatherback sea turtles during the 2022 season, the lowest recorded since 2002. Over the last 20 years (between 2002 and 2022) the average number of nests recorded on Levera beach has been 589.5 ± 305.5 s.d with the highest numbers of confirmed nests (1143) and the highest number of individual nesting females (198) occurring in 2014. Only twenty new leatherback sea turtles were identified and tagged with Monel flipper tags out of the 63 individual turtles recorded in 2022. This is far lower compared to the twenty year average (2002 -2022) of 97 ± 46.3 s.d new females identified and tagged in a season out of an average 164.8 ± 82.4 s.d identified individual female leatherback sea turtles per season. Leatherback sea turtle eggs require a consistent nest temperature of 25-35°C for successful embryonic development and hatching, with sex determination being dependent on the incubation temperature. Based on temperature logger data gathered in 2019 it suggests that hatchling sex ratios were bias to being female. Nest excavations at Levera Beach shown an average hatchling success of leatherback sea turtles over the last decade to be 29.9%; this is well below the global average of 50-55%. Factors associated with the low hatchling success and declining nesting populations in Grenada are currently being investigated.

HIGH PROPORTION OF MALES IN A MARGINAL NESTING AREA OF OLIVE RIDLEY SEA TURTLE COULD DENOTE KEY SITES FOR THE VIABILITY OF THE POPULATION IN THE EASTERN PACIFIC OCEAN

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The olive ridley sea turtle (*Lepidochelys olivacea*), like all species of sea turtles, presents Temperature-Dependent Sex Determination (TSD). Some studies suggest that global warming could be decreasing male production, and consequently affecting the conservation of turtles in many areas as a result of the feminization of the population. However, there are "marginal nesting areas" in the nesting range of sea

turtles, far from the equatorial line, where the temperature for incubation is significantly low as opposed to that of the beaches located near the equator. Therefore, marginal nesting areas could have an important role in recruiting males to the population. The present study was conducted in San Cristobal (SC) and El Suspiro (ES) beaches, monitored for the civil association ASUPMATOMA in Los Cabos, BCS, Mexico, two beaches in the northernmost nesting area for the sea turtle in the Eastern Tropical Pacific. We obtained data on the temperature of the nest through Hobo sensors in the center of the incubation hatcheries and with a statistical model established by Girondot (1999), validated and adjusted by Sandoval (2012) for olive ridleys, we estimated the sex proportion of hatchlings during the 2016, 2017 and 2018 nesting seasons. In the months of July-November, SC beach had a nest temperature range between 25.62°C and 31.18 °C and ES beach between 25.51°C and 31.87°C, both considered to have a suitable temperature range for embryonic development. In the total percentage of males, it was 0.57 for SC beach and 0.47 for ES beach. November was the month with the highest proportion of males with 0.90, even when only a few nests were incubated. On the other hand, September and October, although they had proportions between 0.40 and 0.60, were the most important months for the production of males by having a greater number of nests hatching, and therefore, a greater number of males generated. Proportions found in this study are among the highest recorded for the olive ridley in Mexico (until 2018) which sets a standard to confirm that the beaches at the marginal nesting areas are important for the production of males. Something important to point out is that in our study we never recorded 100% of females, even at the beginning of the hatching season (August and September), as has been seen in other similar studies. Although more data is needed as well as more improved statistical models, these results show a good approach to the importance of these areas in the recruitment of males to the stock of the Eastern Pacific, which is key to maintaining the viability of the species. The concern about the feminization of sea turtle populations due to climate change (due to the determination of sex in which warmer temperatures produce females), is that more attention and research should be put on marginal nesting sites.

BUILD A BETTER BOX FOR SEA TURTLES

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Leaving sea turtle eggs *in situ* is considered the best management practice. However, the pressures of inundation, poaching, and predation can threaten nests left on the beach. Therefore**,** the project at San Pancho, Nayarit, Mexico normally removes all nests to a government-permitted polystyrene nest box nursery. Decades of records indicate hatching success is higher in the box nursery than on the San Pancho beach. However, polystyrene production and consumption are banned in many parts of the world because it fragments easily and does not biodegrade, generating coastal pollution. In 2020, the Science Exchange non-profit, in partnership with the Sea of Change Foundation, held a design contest called “Build a Better Box for Sea Turtles” to replace commonly used polystyrene egg incubators with a more environmentally friendly, functional alternative. We received 10 contest entries that met the requirements. Five were built and tested against the control (polystyrene coolers) for 45 days in the San Pancho box nursery with sand only. We monitored the sand with the Teros-10 soil moisture sensor and Hobo brand pendant thermometers, and qualitatively scored the boxes from 0 (not good) to 5 (great) in durability, environmental friendliness, gas exchange, ease to build, ease to clean, and availability of supplies. The final scores revealed the top three performing boxes were the standard polystyrene cooler, a sphere of woven vines (*Cuahmecate*), and a wooden fruit crate**,** both lined with coconut palm fibers. In the summer of 2022, these three incubators were again tested with sand only in replicates of seven. All the boxes maintained adequate sand temperatures for incubation (25-35 C°), and the trials showed no differences in mean daily sand temperatures (Mann-Whitney tests, $p>0.05$). However, daily max temperatures were higher in the crates and spheres by 6.5 C° ($p<0.05$), and temperatures varied daily by an additional 3.5 C° compared to polystyrene ($p<0.05$). This means the polystyrene performed better as an incubator in this hot region. In the fall of 2022, we improved the experiment by pairing vertically stacked, repurposed wooden fruit crates insulated with sustainable, locally-sourced coconut palm fiber and banana leaves and/or cotton cloth. These were compared with polystyrene boxes in a more controlled interior environment. The spheres were eliminated because they took two hours to weave. We are excited to report that in this trial, there were no differences in daily mean temperatures (Mann-Whitney tests, $p>0.05$). Daily max temperatures were higher in the crates (27.2 vs 26.9 C°) (paired T-test, $p<0.05$) but temperature variance was not different ($p>0.05$). Moisture was slightly lower in the crates by 0.5% ml/ml (Mann-Whitney test, $p<0.05$). However, these statistical differences are likely biologically irrelevant and within the range of instrument error. Therefore, we believe we have developed an eco-friendly incubator to rival traditionally used polystyrene coolers. Testing with eggs is the proposed next phase. We recommend splitting clutches between each prototype so any differences in hatch success and hatchling fitness will be attributable to the incubator. Real-time monitoring and associated mitigation actions (sprinkling) would prevent risks to the embryos during the next trial.

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*21 YEARS OF SEA TURTLE NESTING SURVEYS IN SOUTHEAST COAST OF PUERTO RICO

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Although marine turtles in Puerto Rico have been listed as Endangered and protected by USA federal (1978) and state (1986) laws, it was not until 1984 that regular nesting surveys were initiated to establish population trends. The first nesting beach surveys were conducted on Culebra and Mona Islands (Diez *et al*.2010). Subsequently, surveys were established on other beaches on mainland Puerto Rico, the beaches of the Northeast Ecological Corridor Natural Reserve in 1986 (Horta *et al.* 2003), Humacao on the east coast (Matos 1986) and in Añasco on the west coast in 1993. In 2001, in the beaches along the southeast coast of mainland Puerto Rico standardized nesting surveys were established. Currently, these beaches constitute one of the most important index sites for nesting sea turtles in all of Puerto Rico. Here we summarize data from 21 years of nesting by three species of sea turtles on the beaches of the municipality of Maunabo, along the southeast coast of Puerto Rico. During the 21-year nesting survey period (2001-2021), the total annual nest numbers for leatherback ranged from 53 to 355 per season, and the number of observed hawksbill nests ranged from 15-170 per season. Although green turtle nests are considered rare in Puerto Rico, in the past few years more nesting activity has been documented. From 2013-2021 an increase in green turtle nests has been observed. In 2012 the first nest was registered and in 2021, 30 green turtle nests were observed, suggesting that more nests may be expected in the future.

ASSESSING MICROPLASTIC CONTAMINATION IN UNVIABLE SEA TURTLE EGGS IN NORTHWEST FLORIDA

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Plastics have invaded virtually every habitat on Earth, including marine ecosystems. The impact on aquatic organisms is evident as strandings and necropsies reveal an overwhelming presence of macro and microplastic contamination. Implications of the adverse effects include obstruction to organs, decreased reproductive fitness, translocation, etc. However, in comparison with marine mammals, sea birds, and fishes, sea turtles are the most affected by microplastics in terms of number of individuals impacted and concentration within each organism. The ubiquitous nature and persistence of microplastics in the environment further compromises sea turtles as all seven species are either threatened or endangered. Using sea turtles as biomonitors for microplastic pollution, we aimed to form a more comprehensive investigation of microplastic contamination in the early-stage development of sea turtles. Although previous studies have quantified microplastic accumulation in post-hatchling and juvenile stages, assessments of the presence of microplastic contamination in unviable sea turtle eggs is nonexistent. In partnership with the United States Geological Survey and the Florida Fish and Wildlife Conservation Commission, unviable sea turtle eggs were collected from seven locations along the northwest coast of Florida from loggerhead sea turtles, *Caretta Caretta*. chemical tissue digestion was carried out by using the preferred extraction technique favoring the use of potassium hydroxide (KOH) for its inability to degrade or compromise the integrity of microplastics. Sea turtle eggs were analyzed and microplastics were quantified and characterized. These data will be used to shed light on the extent of microplastic contamination and aid in implementing future sea turtle conservation and management strategies.

EFFECTS OF EARTHQUAKES ON SEA TURTLE NESTING AND INCUBATION SUCCESS ON THE MICHOACAN COAST, MEXICO

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Mexico, due to its geographic position, is one of the countries with more earthquakes in its territory; it is located on the edge of the so-called ring of fire of the Pacific basin where the largest number of volcanoes and earthquakes on the planet are concentrated. The interaction of four large tectonic plates in the national territory (the Pacific plate, the Cocos plate, the North American plate and the Caribbean plate) causes regular telluric movements with intensities ranging from 8.2 on the Richter scale (June 3, 1932, Colima, Mexico) to imperceptible earthquakes. There is little information on the effects of earthquakes on sea turtle nests in Mexico. In September 2022 an earthquake with a magnitude of 7.7 Richter occurred with an epicenter on the coast of Michoacan with a duration of 2.44 minutes at 13:40 hrs and a strong aftershock of 6.5 Richter at 02:00 am on September 20. The movement significantly affected the northwestern part of the coast of Michoacan from Pichilinguillo to Boca de Apiza where the main nesting beaches of black turtle (*Chelonia mydas agassizii)* Colola and olive ridley turtle (*Lepidochelys olivacea*) are located in Ixtapilla. The 7.7 Richter earthquake caused an elevation of between 50 and 60 cm of the black turtle nesting area on the coast of Michoacan and the earthquake waves caused compaction and relaxation of the sand on nesting beaches such as Colola, which left longitudinal fissures along the beach. No liquefaction processes characteristic of this type of movement were observed. Preliminary observations at Colola beach, the main nesting site for the black turtle (*Chelonia mydas agassizii)* showed a loss of sand compaction and nesting females had difficulty nesting successfully on several attempts, due to the sand collapsing over the nest. Trenches 1.5 m deep were dug on this beach to observe modifications in the structure of the nests in the protected hatcheries as well as in natural nests. The nesting area of the black sea turtle in the beaches of Colola, Xicuasa, Maruata, Paso de Noria and Motin del Oro, where approximately 80% of this population is concentrated worldwide, is subject to earthquakes of great magnitude that can cause effects on sand compaction that affect the nesting success of nesting females and the survival of hatchlings through the modification of the structure of the nests. Earthquakes on the coast of Michoacan add to the list of threats to the recovery of sea turtle populations, due to the high concentration of reproductive effort of a population in a relatively small area.

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*THE HAWAIʻI ISLAND HAWKSBILL PROJECT

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The Hawaiʻi Island Hawksbill Project (HIHP), a project of the Pacific Cooperative Studies Unit (PCSU) and the Hawaiʻi Volcanoes National Park based at Hawaiʻi Volcanoes National Park, was founded in 1989 and has monitored hawksbill nesting activity since. The HIHP monitors the most important hawksbill nesting beaches in Hawaiʻi, which historically account for >85% of the nests laid across the State, although substantial nesting was recently documented at a beach on the island of Molokaʻi as well. The HIHP monitoring sites are extremely remote and are on private, county, state, and/or federal lands. A large team is needed to identify nesting activity, collect nesting ecology data, manage and protect nesting habitat and nests, control non-native predators and vegetation, and ensure hawksbill females and hatchlings safely reach the ocean. The HIHP also conducts formal and informal educational outreach events about hawksbills to promote public stewardship of coastal and marine ecosystems. The HIHP includes multiple teams that monitor nesting sites along the southern coast (i.e., Kaʻū_coast) of the Island. These nesting sites are grouped into three nesting complexes based on geography, fidelity by nesting females, and genetics. Each complex consists of one primary nesting beach (Pōhue, Kamehame, ʻĀpua) sorrounded by peripheral, secondary nesting beaches. The isolated nature of each individual complex necessitates substantial staff coordination and effort to reach and to understake monitoring. At each complex, the HIHP teams are responsible for day and night monitoring of nesting hawksbills from May through December each year. Night monitoring consists of beach surveys (1700 – 0600) to record nesting attempts, identify nests, and document hatchling emergences. Day checks are accomplished by hiking and/or driving to the site to look for and document signs of nesting activities (i.e., tracks, nest pits, nest emergences, etc.). These monitoring efforts have been conducted since 1989, while flipper tagging of nesting females started in 1991. Approximately 5 to 25 hawkbill individuals nest annually in Hawaiʻi and a total of 182 nesting females have been tagged since 1991. Recent analysis of our long-term data indicates that although the Hawaiian hawksbill nesting population was initially decreasing, it has been trending positively since 2006. These results are largely attributed to the hawksbill conservation actions spearheaded by HIHP on Hawaiʻi Island. We will share these and other important results of the long-term monitoring efforts by the HIHP team that can support management decision making and the implementation of effective conservation strategies.

CHARACTERIZATION OF THE NESTING SITE OF *LEPIDOCHELYS OLIVACEA* IN PUNTA CHALACATEPEC, JALISCO, MEXICO

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The selection of the site where the females make their nest depends on specific characteristics of the sand, such as the oxygen exchange of the nest, the relative humidity, the beach slope, temperature, and the size of the grain of the sand. These characteristics on nesting beaches greatly influence hatchling developmental success and survival, reproductive success, incubation period, hatchling survival, sex determination, and size and pup growth. The physical and environmental factors of the sand (e.g., temperature, humidity, the distance of the nest from the vegetation, and the mark of the highest tide) can also be determinants in the infestation of the nest chambers by dipteran larvae. The olive ridley turtle, *Lepidochelys olivacea*, chooses beaches with characteristics such as high levels of humidity and close to the mouths of rivers and estuaries, in addition to the inclination and width of the beach and grain size. Therefore, this work aimed to characterize the nesting site of *L. olivacea* in Chalacatepec, Jalisco. This beach measures 14 kilometers and was divided into two parts: north and south; It was transversally divided into Zone A (lower beach zone), Zone B (middle beach zone), and Zone C, which includes the zone where perennial vegetation begins. The data recorded were: the distance between the nest and the highest tide line, beach slope, seawater temperature, sand surface temperature, and sand grain size. Preliminary results show that the average distance traveled by females to oviposit is 22.3m from the highest tide line, with the north beach where the average distance is greater than the south beach, 24.3m and 20.7m, respectively. Regarding the slope of the beach, females had a higher nesting frequency on slopes between 8° and 10°, both on the north and south beaches. The average seawater temperature during nesting was between 29°C and 30.3°C, while the average sand surface temperature was 26.6°C on the north beach and 27.1°C on the south beach. Moreover, for the exact point of the nesting site, the average temperature recorded was 27.5°c. The grain size of the sand that prevailed was between 0.20mm and 0.30mm, considered a small grain size. With these results, it can be concluded that Playa Chalacatepec presents favorable physical and environmental conditions for the nesting and reproduction of *L. olivacea*.

FREQUENCY AND DISTRIBUTION OF OLIVE RIDLEY TURTLE (*LEPIDOCHELYS OLIVACEA*) NESTING EVENTS AT PLAYA CALETAS, GUANACASTE, COSTA RICA

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The Pacific coast of Costa Rica exhibits the nesting activity of four sea turtle species, with olive ridleys turtles (*Lepidochelys olivacea*) being the most abundant and frequently recorded. The Rescue Center for Endangered Marine Species (CREMA), has monitored five olive ridley nesting beaches in Southern Nicoya Peninsula, Costa Rica; from southeast to northeast: Playa Caletas, Costa de Oro, San Miguel, Bejuco, and Corozalito. The sea turtle nesting monitoring project in Playa Caletas started in 2002 due to the concern of several community members about the large number of nesting events and egg poaching occurring without any management or protection. Here, we estimated the frequency of nesting events (successful and unsuccessful) and determined habitat use by olive ridleys at Playa Caletas, for 13 years (2002-2015) of monitoring. We recorded 14,615 olive ridley nesting events during the sampling period (2002 – 2015), with an average of 819.36±465.97 successful nesting events (79.49%), and 219.07±116.56 unsuccessful nesting events (20.99%). Successful nesting events (n= 11,471) were categorized as Protected (49.65%), Poached (8.48%), Predated (19.40%), and Partially Predated (0.96%), meanwhile, Unsuccessful nesting events (n= 3,067) were categorized as Aborted Nests (12.25%) and False Crawls (8.74%) and only 0.53% of events were unidentifiable but referred as an olive ridley nesting record. The highest number of nesting events recorded was in 2014 (2,381 events), and the beginning of the program (2002) showed the lowest number (295 nesting events). Olive ridley nesting activity fluctuated over the years, keeping an average of 1043.93±582.47 nesting events per year, and Playa Caletas was the most frequently used beach by olive ridleys in the area. Both predation and poaching decreased after setting a monitoring program at Playa Caletas, and the noticeable increase in trends of nesting activity of olive ridleys in the study area (14,615 olive ridley nesting events) was key to the creation of the National Wildlife Refuge Caletas-Arío, a new

Marine Protected Area to protect this nesting beach. This protective action encouraged sustainable fisheries and prohibited destructive fishing activities (e.g., trawlers) that affected the sea turtles and the marine wildlife in the area. The distribution of the nesting activity along the beach is highly homogenous, with distinct peaks of activity at the northern and southern end of the beach, and areas with zero or no activity recorded mostly towards the center of the beach. Unfortunately, monitoring efforts were terminated in 2015 due to safety concerns about the participants and staff members. Little is known about the recent nesting activity and the status of the sea turtle population that uses this beach as a nesting area.

MATERNAL INVESTMENT OF HAWKSBILL SEA TURTLES: VARIATION IN EGG AND HATCHLING SIZE ON LONG ISLAND, ANTIGUA

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Offspring size is a primary determinant of survival and thus fitness. Therefore, documenting patterns in egg and hatchling size, and clarifying drivers of variation therein, can improve our understanding of population dynamics. Here, we investigate the difference in maternal investment among hawksbill sea turtles on Long Island, Antigua and how it varies between mothers and their successive nests throughout the nesting season for hatchling and egg size and weight. Additionally, we are comparing the curved carapace length (CCL) of the mothers to the CCL of their offspring to determine whether larger females have larger hatchlings. During the 2022 nesting season, we measured and weighed both hatchlings and eggs to document population-level and nest-level variation, selecting nests opportunistically and aiming for a minimum sample of 5-10 per nest. Hourly nesting patrols were done to document all nests, check or insert flipper tags, and observe hatching events. We document unique patterns in variation, with some individuals producing more variable offspring sizes than others. Additionally, we use linear models to relate egg and hatchling size to maternal size (in terms of CCL at nesting). Our findings suggest that maternal investment in offspring size can vary drastically among nesting females in a given season, with important implications for fitness that merit further examination.

ESTIMATE OF NESTING POPULATION AND CONSERVATION OF SEA TURTLES ON THE BEACHES OF PUIPUY AND CHAGUARAMA DE SOTILLO, PARIA PENINSULA, SUCRE STATE, VENEZUELA

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The beaches of Puipuy (coordinates 10.718514 quot; latitude North and 62.992971 quot; longitude West and Chaguarama de Sotillo (coordinates 10.70389 quot; latitude North and 62.98833 quot; longitude West) are situated in the Northeast of the Paria Peninsula, Sucre State, and are adjoining places but with different characteristics. The *Dermochelys coriacea* (Leatherback) turtle spawns predominantly at the first beach, and at the second, the *Caretta caretta* (Loggerhead) turtle. Both are classified as vulnerable by the IUCN. The chief aim of the project is to promote the conservation of these species and their environment, assessing

the size of the nesting population and protecting their nests. Both beaches were monitored between the months of March and September from 2015 up to the present, with daily censuses, occasional night patrols and relocation of nests threatened by flooding or sacking. In 2022, at Puipuy, we started the marking of nesting females and the measurement of beach profile. Field work is complemented withthe promotion of focused environmental education in basic workshops on the conservation of different species, as well as cultural and sporting activities. In 8 years, the Project has protected more than 280 nests and freed more than 7,000 hatchlings. In the year 2015 at Puipuy 45 Leatherback turtle events were recorded, and at Chaguarama de Sotillo 21 Loggerhead turtle events, in contrast to the data recorded for the year 2022: only 10 Leatherback turtle events and 3 Loggerhead turtle events were counted at Puipuy beach, and at Chaguarama de Sotillo Leatherback spawning increased to 11 but with zero events for Loggerheads. The population tendency has decreased since the year 2017 at both beaches, mainly for the Loggerhead turtle which stopped spawning at its principal beach. That same year a spill of 300 barrels of oil occurred in Trinidad and Tobago, at the Pointe a Pierre refinery of the PetroTrin state company. In the year 2022 the rising sea level and the presence of surface sea currents caused the erosion and accretion of sand banks in the coastal area of Puipuy beach; measurement of the beach profile confirmed that the incline obstructed the access of turtles to the beach during the peak nesting months, causing the decrease in events at this location as compared to previous years and an increase in events recorded for Leatherbacks at the neighboring Chaguarama de Sotillo beach, influenced also by the absence of coastal development at Chaguarama. These sea currents(undertow) also pulled down coconut palms, spreading excess vegetation along the whole shore, which limited access both for the females and for the hatchlings; two nests were flooded and others smothered by shifting sand. The environmental educational activities provided pedagogical tools on various subjects important for conservation, benefitting more than 200 children, teachers and adults from the community. Donations of books, study and sporting materials and toys were also donated.

SETTING A BASELINE FOR NESTING SEA TURTLE ABUNDANCE IN ANTIGUA, WEST INDIES

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Three sea turtle species nests on the island of Antigua: hawksbills (*Eretmochelys imbricata*), greens (*Chelonia mydas*), and leatherbacks (*Dermochelys coriacea*). Opportunistic flipper tagging beginning in 2009 has produced valuable information, but there has been a great need for consistent monitoring efforts to set a baseline for nesting sea turtle abundance and understand population trends. Here, we introduce the Antigua Marine Conservation Programme (AMCP), which was launched in 2021 to systematically survey Antiguan sea turtle nesting. In year one, we trained over 70 volunteers to conduct index beach monitoring of nesting and hatching activity. Through regular patrols of ten beaches (~4.9km of shoreline; 3 July – 15 Nov), we documented an estimated 13 individual hawksbills (CCL: 83.66 cm ± 3.89, n: 6) and four greens nesting at index sites. Thirteen hawksbill nests were excavated post-emergence, producing an average clutch size of 134.7 ± 41.926 eggs and hatching success of 80.7% ± 18.8%. Two green turtle nests were excavated post-emergence, producing an average clutch size of 123.5 ± 0.5 eggs and hatching successes of 76.5% ± 5.6%. This low success rate was mostly due to heavy mongoose predation on one of the excavated nests. A total of 22 recorded nests were threatened by artificial lighting. With intervention, hatchlings from 16 of these nests were successfully captured and released, while six saw complete or partial disorientation. Predation from invasive mongoose also posed a large threat, and 100% of observed hawksbill nests on one beach suffered predation. This first year of monitoring provides an important baseline for future comparison, and we plan to include leatherback monitoring in future years. The AMCP plans to continue annual monitoring and will use nesting data to inform national and regional conservation.

NESTING ACTIVITY OF OLIVE RIDLEY AND EFFECT OF ARTIFICIAL SHADE AT CASCAJILLOSO BEACH, A NEW INHABITED NESTING SITE IN PACIFIC PANAMA

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Sea turtle nesting activity on new beaches yields important data to support future regional and global conservation assessments. Here we report on nesting activity of Olive Ridley (*Lepidochelys olivacea*) at Cascajilloso Beach in Pacific Panama based on data from a new hatchery during seasons 2019, 2020 and 2021. Besides, we conducted a field experiment analyzing the effects of artificial shading on hatchlings' biometric characteristics, hatching success and the incubation period. Nesting activity based on number of egg clutches transferred to the hatchery reached a peak between September (33%) and October (25%). Curved carapace length (CCL) of nesting females (64.3 – 66.2 cm) was similar to other populations of the Easter Tropical Pacific (ETP). The mean number of collected eggs was 8167.33 ± 1733.15 (mean ± SD), however the clutch size was slightly smaller (91.5 to 94.5 eggs) compared with other populations of the ETP. This could be a phenotypic variation of nesting females at this beach. Reproductive success was lower (75± 20 %) in 2020 due to COVID19 restrictions limiting the work at the hatchery. Heavy rainfall during the incubation period had an effect on the nest temperatures registered under artificial shade and direct sunlight treatments (maximum average 29.9 °C), potentially resulting in males. The warmer temperatures in our experimental nests produced heavier hatchlings contrary to general assumptions, but this was also related to straight carapace length only after a threshold value of 40 mm. Hatchlings under the artificial shade were able to grow to a certain size but potentially at the costs of storing less mass (trade-off). The ongoing beach patrolling and hatchery management techniques with long-term baseline data collection are needed to secure the nesting population of *L. olivacea* at this recently surveyed beach.

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*FROM TERRA INCOGNITA TO HOTSPOT: THE LARGEST SOUTH PACIFIC GREEN TURTLE NESTING POPULATION IN THE FORGOTTEN REEFS OF NEW CALEDONIA

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Green turtle, *Chelonia mydas*, is a large marine turtle present in tropical and subtropical seas around the world, notably in the Atlantic, Pacific and Indian Oceans. It is listed as endangered under criteria A2bd of the 2004 IUCN Red List evaluation based on the trend of nesting populations at 32 sites of which only 3 are in the Pacific Ocean. New Caledonia is a *sui generis* territory of overseas France in the southwest Pacific Ocean located about 1,210 km east of Australia. The presence of green turtles within New Caledonian waters is known, although the main nesting sites are located far from main island in remote uninhabited islands. Since 1988, field missions in these remote reefs, namely d'Entrecasteaux, Bellon a and Chesterfield reefs, have collected data to quantify the nesting of green turtles in New Caledonia. For the first time, we analyse the data collected during these missions. D'Entrecasteaux, Bellona and

Chesterfield reefs host a huge nesting colony of green turtles with the lower credible estimate of nesting activities reaching 150,000 nesting tracks for some years. These numbers exceed the estimated number of green turtle activities in the Pacific. The trend of the number of nesting activities is stable and has the same relationship with the Southern Oscillation Index as observed at other Australian nesting sites. Our recommendations for the French authorities are to continue monitoring these populations, collect new demographic parameters and ensure the protection of these remote reefs, which should be considered a "national treasure for New Caledonia."

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*ADAPTATION OF SEA TURTLES TO CLIMATE CHANGE: WILL PHENOLOGICAL RESPONSES BE SUFFICIENT TO COUNTERACT CHANGES IN REPRODUCTIVE OUTPUT?

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Sea turtles are particularly vulnerable to climate change since their reproductive output is influenced by incubating temperatures, with warmer temperatures causing lower hatching success and increased feminization of embryos. Their ability to cope with projected increases in temperatures will depend on their capacity to adapt to shifts in climatic regimes. Here, we assessed the extent to which phenological shifts across 26 important nesting sites, for four species of sea turtles, could mitigate impacts from increases in incubation temperatures, under a 'business as usual' scenario. Sand temperatures at sea turtle nesting sites are projected to increase from 0.8 to 7 °C by 2100, and expected shifts in nesting by 30-49 days earlier, will not be sufficient to maintain current trends in sex ratio, which will result in a feminization of most nesting sites. However, phenological shifts might ameliorate the projected reductions in hatching success at some locations. Nesting sites further from the equator (> 30° latitude) were shown to have the greatest capacity to buffer impacts of predicted increases in nest temperatures. Thus, these sites are good candidates for continued protection and conservation. However, if other possible mechanisms of adaptation are not successful there will be the need to enhance sea turtle resilience to climate change by mitigating other threats that they currently face as this will help vulnerable and depleted populations better cope with disturbances.

DETECTION THRESHOLDS FOR GREEN AND ORANGE LIGHT IN *ERETMOCHELYS IMBRICATA* HATCHLINGS

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Anthropogenic lights cause hatchling turtles to misorient on nesting beaches, leading to decreased survivorship. Installing turtle-safe lights on and around developed nesting beaches is an effective way to reduce hatchling misorientation while allowing illumination of beachfront property. However, what a

"turtle-safe" light is may be species specific. Studies on green and loggerhead turtles have found they are least attracted to red lights compared to green or blue lights. However, these lights can still attract hatchlings. Knowing the intensities at which different colors of light no longer attract turtles (threshold of detection) is of paramount importance for turtle-safe lighting practices. Hawksbill turtles have not yet been investigated for detection thresholds and may prove more sensitive to light due to their preference for nesting in dense vegetation where light levels are low. To study hawksbill hatchling detection thresholds for orange and green light we used a Y-maze choice experiments. The maze was 0.5 m long and constructed of 10.2 cm D PVC pipe cut along the long axis 2.5 cm above the center line for easy retrieval of hatchlings post-experimentation. An antechamber with an opaque portcullis was connected to the maze, and the maze was filled with ~2 cm of sand from the natal beach to provide a natural substrate for the hatchlings to move across. The magnetic orientation of the maze and the illuminated arm of the maze were randomized while the maze was kept level to control for gravitropism. Hatchlings were presented with a light stimulus of either green (555 nm) or orange (601 nm) created by six surface-mounted device (SMD) LED lights, while the intensity of the lights was controlled using neutral density filters. Light intensity was measured pre-experimentation using a S400 Optical Meter and S247 Flat-Response Sensor Head situated at the decision point of the maze, approximately 1 cm above the sand. Hatchlings collected from the nest at emergence were kept in cool, dark conditions until experimentation. Each hatchling was chosen randomly for experimentation and tested only once. To determine thresholds, hatchlings were tested using the up-down staircase statistical method, using 1.0 log steps down and 0.3 and 0.7 log steps up. A one-tailed binomial test was used to determine if a significant number of hatchlings were attracted to a specific intensity of light. Initial results suggest that hawksbills are more sensitive (i.e. lower detection threshold, and thus greater attraction) to green wavelengths of light than either green or loggerhead hatchlings, and more sensitive to orange wavelengths of light than green turtle hatchlings. In this study I provide the first estimates for hawksbill detection thresholds for green (555 nm) and orange (601 nm) light as determined by a Y-maze choice experiments. We plan to conduct further studies of detection thresholds for hawksbill hatchlings across the visual spectrum to further elucidate possible differences in light sensitivity across species. Our results may be critical for beachfront lighting as we illustrate that even at very low intensities, light within the red-orange range of the spectrum may still attract hatchlings.

SEASONAL VARIATION IN CLUTCH SIZES OF LEATHERBACK SEA TURTLES IN SOROPTA BEACH, BOCAS DEL TORO, PANAMA (2013-2022)

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Leatherback sea turtles (*Dermochelys coriacea*) have a wide distribution around the globe and some populations choose the Caribbean beaches as nesting grounds. The Sea Turtle Conservancy is present in Panama since 2003, starting its monitoring activity in Soropta in 2013. Soropta beach is a 6 km black sand beach on the Panamanian Caribbean coast, located in the wetlands of San San-Pond Sack. Soropta is, predominantly, a leatherback turtle rookery with occasional hawksbill nests. The nesting season runs from March to July, having between 400 to 1400 nests every season. Unlike other Caribbean beaches that are showing a decline in nesting activity of leatherback turtles, Soropta's nest numbers seem to follow a positive trend since 2013. Numerous studies have been carried out on clutch size interannual variability or clutch size means compared to individual biometric parameters, clutch frequency, or remigration frequency. However, clutch size differences within the season and the factors that affect it are poorly studied. Existing studies often show contradictory or inconclusive results, given high individual variability and limited samples. Thus, conclusive information remains unclear. The main objective of this study is to analyze the existing information about clutch sizes across the season at Soropta beach covering a 10-year span. This will help to better understand the nesting behavior of this population and settle down the bases for future conservation strategies. A sample of nests was marked every season during the night patrols. To do this, eggs were counted by hand as they were being laid, using red light to distinguish between yolked and yolkless eggs. We analysed the clutch size throughout the nesting season with data collected from March to June between 2013 and 2022, calculating mean clutch size per month and year for the whole period. A total number of 1803 egg clutches, along the 4,6 kms monitored of Soropta beach for a 10-year period, were included in the study. The ten years mean clutch size was 78. Also, we found that the mean clutch size per month is higher at the peak of the season (April, 79.8) compared to both, the beginning (March, 76.9) and the end (June, 73.9). Almost all the years showed similar results, with some exceptions, in which clutch sizes seems to be higher at the beginning (2018) or at the end (2014 and 2016) of the nesting season. Our study is a basic approximation to describe nesting behavior in Soropta. It aims to highlight the importance of having a better understanding of both individual and population seasonal changes in clutch size, helping to minimize errors related to individual and annual intrinsic variability. This implies the need to increase efforts and achieve a higher percentage of analyzed nests of a beach. Likewise, this knowledge can help to design different conservation strategies related with hatchery management, monitoring protocols, or poaching minimization, depending on the period of highest reproductive output of the beach.

WARMER AIR TEMPERATURES DO NOT NEGATIVELY AFFECT BODY SIZE AND EMERGENCE SUCCESS OF LOGGERHEAD TURTLE (*CARETTA CARETTA*) HATCHLINGS AT YAKUSHIMA ISLAND, JAPAN, THE LARGEST ROOKERY IN THE NORTH PACIFIC

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Knowledge of the determinants of population size is essential for effective conservation and management of endangered species. Population growth is dependent on offspring survival. Initial survival of sea turtle offspring is subject to the incubation environment, where higher incubation temperatures negatively affect their vigour and morphology. Thus, at some rookeries with drastic fluctuations in sand temperature, hatchling characteristics have been demonstrated to exhibit seasonal and annual variation. We examined whether body size and emergence success of loggerhead turtle (*Caretta caretta*) hatchlings decline seasonally at a temperate rookery (Yakushima Island, Japan) in correlation with the seasonal rise in air temperature. Clutches collected during two survey periods within the same nesting season were incubated on the same beach hatchery over two years. The body size of adult females that laid experimental clutches was not significantly different between the survey periods. Corresponding to seasonally rising air temperatures, incubation duration for clutches of the first survey period was significantly longer than that of the second. However, both hatchling size and emergence success did not decrease seasonally, and there were no significant negative correlations between the mean air temperature or the estimated mean sand temperature during incubation and the hatchling characteristics. These may be due to a combination of coarse white sand and high rainfall on the experimental beach, which might have lowered sand and nest temperatures and elevated sand moisture. Seasonal stability in hatchling characteristics may be one of the reasons Yakushima Island is the largest rookery for loggerhead turtles in the North Pacific.

CORRELATION BETWEEN ENVIRONMENTAL FACTORS, NEST TEMPERATURE, AND SEX RATIOS IN THE OLIVE RIDLEY FROM MORRO AYUTA BEACH, OAXACA, MEXICO

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Anthropogenic activities have been interfering with the planet's energy balance, mainly by burning fossil fuels that add carbon dioxide to the air. Different proxies like fossil records, ice cores, or corals have demonstrated that the earth's temperature has risen during the last half-century. Climate change risk is particularly pronounced for marine ectotherm species, as their thermal tolerance limits are much narrower than terrestrial ectotherms in different life cycle stages. Most studies in marine turtles have estimated current female-biased sex ratios and embryonic mortality in the nest where the temperature is above 34°C for more than three consecutive days. In the long term, the sum of these risks can lead these species to extinction. In *Lepidochelys olivacea*, the only turtle species in the Mexican Pacific with massive nesting called "arribadas," changes in the geographic latitude among beaches define and drive the global status of the species. In previous studies in our laboratory, eggs were incubated at constant temperatures, 26ºC and 33ºC, producing 100% males and 100% females, respectively. In turn, the incubation periods were around 45 and 75 days for female and male-producing temperatures. However, the data obtained in the laboratory requires being validated in the oscillating temperatures of natural nests. We placed temperature loggers (HOBOware) in the center of 23 in situ nests during three arribada events in the 2020-2021 nesting season in Morro Ayuta beach, Oaxaca. Simultaneously, a weather station (DAVIS) installed on the same beach registered solar radiation, precipitation, and air temperature. Temperature profiles were collected from 20 nests, of which only ten were viable. Moreover, ≤10 hatchlings were sampled from each viable nest and obtained sex ratios (histological techniques), hatching success, and hatchling body size. Our preliminary results indicate that air temperature does not directly correlate with nest temperature since these buffer short-term environmental fluctuations. However, precipitation (above 50mm of rain) significantly lowers the temperature of the nests. Thus, if this rainfall level occurs during sex determination (stages 23-26), the number of males will increase at high feminizing temperatures. The rainfall at the end, during the last third of incubation, mitigates the temperature generated by the metabolic heat of the nest, increasing survival. Finally, we observed a decrease in the nest's temperature concomitant with the reduction in solar radiation levels. This decrease coincides with days of heavy rain and in the absence of rain.

*RESPONSE OF HATCHLING GREEN (*CHELONIA MYDAS*) AND HAWKSBILL (*ERETMOCHELYS IMBRICATA*) SEA TURTLES TO ACOUSTIC CUES

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Although sea turtle hearing range is known, the impact of anthropogenic sounds is less explored. We examined the response of green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtle hatchlings to environmental and anthropogenic sounds present on the nesting beach. Sound recordings were made directly on the nesting beach and within hatchlings' hearing range of 50-800 Hz for greens and 50-

1600 Hz for hawksbills. Environmental sounds included beach wave sounds (50–1000 Hz) and avian predator vocalizations (0-18,000 Hz), while anthropogenic sounds included human conversation (0-10,000 Hz) and vehicle traffic noise (0-40,000 Hz). Some anthropogenic sounds were examined at two volumes to simulate 'crowded' and 'less crowded' scenarios. Due to nesting numbers, hawksbills were only tested for their response to beach wave sounds and avian predator vocalizations. In the presence of beach wave sounds and avian predator vocalizations, green and hawksbills showed no significant orientation pattern. No significant orientation response was exhibited by greens in the presence of human conversations or vehicle traffic noise. While no significant findings were observed, limitations may be due to the hatchlings inability to localize in-air sound sources. Additionally, sound cues may be a secondary orientation cue when other stimuli, such as light and sound vibrations, are present.

ACTIONS FOR THE CONSERVATION, MONITORING AND PROTECTION OF THE LEATHERBACK TURTLE, AS WELL AS TWO OTHER SPECIES IN PLAYA BARRA DE LA CRUZ – PLAYA GRANDE, OAXACA, MEXICO, THE 2021-2022 NESTING SEASON, AND THE PRELIMINARIES OF THE 2022-2023

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Barra de la Cruz Beach - Playa Grande, in the state of Oaxaca with a length of 8.7 km, was declared in 2008 as a RAMSAR Site 1821 wetland of international importance, it is also considered one of the 4 most important index beaches in Mexico for leatherback turtles (*Dermochelys coriacea*) in the eastern Pacific. It has a destination agreement since 2012 for the use of protection and conservation of sea turtles, granted to the National Commission of Natural Protected Areas (CONANP). According to the IUCN (2018), the world population of this sea turtle vulnerable. However, in the specific case of the population of the Eastern Pacific, it is listed as critically endangered, which is also listed as an endangered species according to the Official Mexican Standards (NOM-059-SEMARNAT-2010). The beach is monitored by the Mexican Turtle Center. The actions and success in the results of conservation, monitoring and protection in this nesting beach have been collected by the combined efforts of the government institution, in collaboration with Kutzari, Association for the Study and Conservation of Sea Turtles A.C. (KUTZARI); the community participation of two groups of monitors from the surrounding towns, beneficiaries of the Program for the Protection and Restoration of Ecosystems and Priority Species (PROREST); the participation of community brigade members of the CI-GEF-CONANP Project "Landscapes Sustainable Development of Oaxaca and Chiapas" of the Global Fund for the Environment (GEF) and the support of the two Municipal Agencies of both communities. These results represent the positive impact of aal of the efforts to protect the beach and the sea turtles that nest in this area, the management of these species is within the National Sea Turtle Program and the Láud Project. Methods: Carrying out the population monitoring program with standardized methods, mainly aimed at protecting the clutches by relocating them to pens, to recruit the largest number of healthy hatchlings to the population, as well as monitoring and estimating the nesting population. Results: 335 leatherback turtle clutches, 92 black[ah1] turtle clutches and 517 olive ridley clutches were confirmed, for a total of 944 confirmed clutches. In the specific case of the leatherback sea turtle, laying success was 90.5%, being the highest percentage registered of the three species. Of the 391 registered nesting activities, in 311 the female was observed. Thus, metallic tags were placed on 98.9% of the nesting females and electronic tags on 96.8%. In this way, it was possible to identify 76 neophyte females and 18 remigrant females, with a total of 94 females. A protection of 99% of confirmed clutches was achieved.

DUNE ECOSYSTEM RESTORATION TO REDUCE THE IMPACT OF GLOBAL WARMING ON THE REPRODUCTION OF SEA TURTLES

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Marine and coastal ecosystems are changing at an unprecedented rate due to human activity, inducing environmental changes at regional and global scales. Anthropogenic climate change in particular is disrupting numerous beach ecosystem processes with negative impacts on sea turtles. Such impacts include alterations in water and air temperature, sea level rise (SLR), ocean acidification, and coastal erosion. These alterations negatively affect the incubation of sea turtle nests with increases in embryo mortality, reduction of hatchling performance, and strong feminization of hatchlings, among other impacts. Traditional restoration of beaches, mainly oriented to the touristic sector, has been based on beach nourishment and the establishment of vascular plants such as seagrass and dune grass. However, in the last years, it has been evident the need for large-scale coastal adaptation projects to strengthen coastal biodiversity and ecosystem multifunctionality. This focus may be helpful to reduce the impact of beach degradation on the incubation of sea turtle nests. Cabo Verde archipelago hosts the largest loggerhead sea turtle nesting population. In the last decades, rising temperatures are severely threatening embryonic development in their main nesting beaches. Additionally, the main nesting beaches have suffered severe deforestation by human activities in the nidification areas. This deforestation may substantially increase the level of insolation of loggerhead nests, as well as several other threats to turtle nests. In this study, we have evaluated the potential influence of arboreal and brush vegetation to decrease the impact of high incubation temperatures. Sand temperature at mean nest depth (40 cm) has been measured in locations fully exposed to the sun and shaded beach areas by autochthonus vegetation. The only plant species that can provide shade to nests in this ecosystem are the endemic palm tree (*Phoenix atlantica*) and the African tamarisk (*Tamarix senegalensis*). However, these species have been exploited by humans and cattle (donkeys and goats) for centuries and are now very scarce in Cabo Verde archipelago. In order to understand the influence of the decrease of 1 to 2 degrees of temperature in loggerhead turtle nests, artificial shading techniques were evaluated in a beach hatchery. Two types of artificial shading have been used: dry leaves of palm trees and polyethylene shade mesh. The results showed significant differences in incubation temperature (hatcheries with shading with an average decrease of temperature of 2°C), as well as in incubation duration (hatcheries with shading with a delay of ≈7 days) and sex-ratio estimates (hatcheries with shading with a 50:50 while sun exposure 100% of female). No impact was observed in hatching success and hatchling phenotype. These results indicate that the natural and artificial shading of the beach surface can mitigate the impact of global warming in important turtle rookeries. However, artificial shading should only be recommended as an urgent provisional measure. In the medium and long term, natural shade is much more sustainable and a more efficient restoration process. The commitment to ecological restoration of dune ecosystems can significantly increase the resilience of sea turtles to the severe impact of global warming.

EFFECT OF NEST ABUNDANCE OF SEA TURTLES ON EGG PREDATION RATE BY GHOST CRABS

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Sea turtles are very often facing intense nest predation globally. This threat could have a particular effect over endangered populations and dispersal events in response to global changes. The main ecological drivers that can affect nest predation have been evaluated in the Loggerhead population of the Cabo Verde Archipelago, which is categorized as Endangered on the IUCN List. In this island rookery, ghost crabs (*Ocypode cursor*) very often exert very high predation rates on turtle nests and hatchlings. Recently, this population has experienced a sudden and strong increase in nest abundance and a strong increase in observations of hatchlings crawling on the beaches. This study investigates the potential effect of Loggerheads nest abundance on nest predation by ghost crabs, on Tartaruga Natural Reserve, the island of Boa Vista, Cabo Verde, from 2013 to 2021, including seasons with low and high nest abundance. Boa Vista hosts around 60% of the Loggerhead nests in Cabo Verde, which is one of the world's largest Loggerhead rookeries. Nest abundance was recorded daily throughout the entire nesting season (June to October) during night patrols and beach surveys at dawn. The predation of ghost crabs was evaluated using natural Loggerhead nests that were studied during egg laying and tagged with visible sticks immediately after egg laying. The clutch size and the precise location were recorded for each nest. All tagged nests were checked daily for any evidence of predation, inundation, erosion, or any other relevant disturbances to the nest. The number of crab burrows was counted daily for each nest and was used as evidence of predation intensity. The clutch size of these nests was counted during oviposition and the nests were exhumed after the incubation period to assess the number of hatched, enclosed, and missing eggs. Any evidence of predation in the nest was evaluated. Ghost crabs were the only natural predators of turtle nests observed during the study. The interannual variability in Loggerhead nests was high, ranging from 1123 in 2015 to 33496 in 2021. The nest mortality by crab predation was strongly negatively correlated to the nest abundance. Seasons with a low nest abundance showed high crab predation rates of up to 75%, whereas in seasons with high nest abundance crab predation rates as low as 4% were observed. Higher nest abundance might exceed the ghost crab capacity to consume sea turtle eggs on the studied beach. Due to predator satiation with high nest abundance, the risk and the extent of predation may be reduced. The findings give an interesting insight into this prey-predator interaction but also highlight the importance of conservation efforts in reducing predation, especially for areas and seasons with low sea turtle nest abundance. An increase in crab predation could be expected in periods of high nest abundance. However, turtle eggs are only available during the incubation period (5-6 months) and crabs must feed during the entire year. High interannual variability in nest abundance could have been selected as a natural strategy to reduce overall nest predation.

*SPECIES TURN-OVER ON GANDOCA BEACH, COSTA RICA: ONCE IMPORTANT FOR LEATHERBACK NESTING, IT IS NOW CONSIDERED TO BE THE MOST IMPORTANT NESTING SITE FOR THE CRITICALLY ENDANGERED HAWKSBILL TURTLE (*ERETMOCHELYS IMBRICATA*) IN CARIBBEAN COSTA RICA

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Playa Gandoca is a 9.8 km beach located within the Gandoca-Manzanillo National Wildlife Refuge on the Southern Caribbean coast of Costa Rica. It is an important sea turtle nesting beach where the critically endangered hawksbill turtle (*Eretmochelys imbricata*) shares the beach with two other sea turtle species, the endangered leatherback (*Dermochelys coriacea*) and the endangered green turtle (*Chelonia mydas*). The main threats for sea turtles in Gandoca are severe beach erosion, the illegal harvest of eggs, and the killing of adult hawksbill turtles for tortoiseshell, besides the regular natural predation. Previously existing monitoring and conservation efforts, from 1990 to 2010, were mainly focused on the leatherback turtle, the dominant species at that time, and ceased in August each year. However, these efforts were suspended, leaving the beach unmonitored for ten years. In 2020, although leatherback turtle nesting had decreased substantially, according to observations from locals, we reinstalled a monitoring project reacting to reports from villagers about a supposed increase in hawksbill nesting. Since then, we have continued research and conservation measures for all three species. Here, we are presenting data from nesting activities of the hawksbill population collected during our first three nesting seasons, 2020, 2021, and 2022. From March until October, the beach is monitored every night in shifts from 19:30 until 4:30 hours, searching for nesting females. Once a female is encountered, we collect morphometric data, tag new individuals, and relocate every clutch of eggs *in situ* higher up on the beach, hidden because clutches left naturally are usually lost to erosion, predated, or illegally harvested. In the three years since our project started, we observed a peak in hawksbill nesting activity during June and August each season. We recorded a mean of 128.7±27.06 clutches per season ($\bar{x}$±SD, range 99-152, n=3) and were able to identify a total of 88 nesting females with an annual mean of 29±5.13 females ($\bar{x}$±SD, range 25-35, n=88). These numbers are almost twice as high as for Cahuita beach, allegedly the most important nesting beach for hawksbills on Costa Rica's Caribbean coast. The mean curved carapace length (CCL) of nesting females was 86.90±1.31 cm ($\bar{x}$±SD, range 76.9-96.6, n=99), and the curved carapace width (CCW) was 77.25±0.45 cm ($\bar{x}$±SD, range 67.7-88.8 n=99). The recorded mean number of eggs per clutch was 154.24±4.23 ($\bar{x}$±SD, range 34-226, n=311) that hatched with a mean success of 71.11±2.66 % ($\bar{x}$±SD, range 0-100%, n=243). That way, we were able to release a total of 31.015 hatchlings safely to the ocean within the past three seasons. Our results suggest that Playa Gandoca is now, at the very least, one of the most important nesting beaches for the Caribbean hawksbill population in Costa Rica, if not the most important one.

EFFECT OF NATURAL AND ARTIFICIAL SHADING ON THE HATCHING SUCCESS OF GREEN (*CHELONIA MYDAS*) AND LEATHERBACK TURTLES (*DERMOCHELYS CORIACEA*)

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Green (*Chelonia mydas*) and leatherback sea turtles (*Dermochelys coriacea*) are considered globally endangered of and vulnerable to extinction, respectively. Thus, studies targeting these two species usually have a conservation focus. Temperature is one of the main factors to determine hatching success of sea turtle nests, and shading is one of the main methods to control nest temperature at hatcheries. To optimize nest management techniques employed by conservation organizations, we examined the impact of natural and artificial shading on the hatching success on green and leatherback turtle nests relocated to a hatchery in the community of Barra de Parismina, on the Caribbean coast of Costa Rica. At Barra de Parismina, preparations for the hatchery start prior to the nesting season, and all the sand within the chosen area is dug up to 1 m of depth and sieved to remove debris. The leatherback and green turtle hatcheries were separate and both grided in a way that each nest has an alpha-numeric code. Leatherback nests were incubated at 70 cm of depth and one meter apart. Green turtle nests were incubated at 60 cm depth and 80 cm apart. For one week, we checked each hatchery hourly throughout the day (5am-6pm) and created a shade croquis to understand the amount of sun exposure that each nest was subjected to. “Exposed nests” received more than 6 hours of direct sun exposure per day, whereas “naturally shaded” nests were shaded by nearby trees and received at most 2 hours of direct sun exposure per day. We also “artificially shaded” a sample of exposed green turtle nests using a mesh made of woven palm tree leaves. Nests were excavated after hatching signs were evident, and hatching success was calculated. We compared hatching success in 32 exposed and 24 naturally shaded leatherback nests. Natural shade was shown to significantly improve hatching success ($mean_{shaded} = 0.47$, $mean_{exposed} = 0.27$, $p < 0.05$). We compared 17 exposed and 32 naturally shaded green turtle nests. Natural shade had no significant effect on hatching success ($mean_{shaded} = 0.750$, $mean_{exposed} = 0.698$, $p > 0.05$). Artificial shading also did not affect hatching success significantly when we compared exposed nests (n=17) and artificially shaded nests (n=15) ($mean_{exposed}= 0.698$, $mean_{shaded}=0.741$, $p > 0.05$). Concluding, shade improves the hatching success of leatherback turtle nests likely by keeping nests at a better temperature for incubation. By applying shading to leatherback nests, conservation organizations can maximize hatchling production, which is the main objective of building a hatchery to incubate sea turtle eggs. However, we suggest that future studies also analyze temperature at nest depth to understand the effects of shading in the sex ratios of hatchlings produced. On the other hand, shading of green turtle nests seems not to be necessary or a useful tool for hatchery management on the Caribbean coast of Costa Rica. This is in accordance with the fact that green turtle embryos can develop under a wider range of incubation temperatures than leatherback turtle embryos.

FIRST NESTING RECORD OF LEATHERBACK SEA TURTLES AT LA PLAYITA, MACHALILLA NATIONAL PARK, ECUADOR AND PUERTO RICO BEACH

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Leatherback sea turtles are considered rare in South America as they are not commonly seen at nesting beaches; most records of this species are from bycatch, and by stranding events of dead animals. Using satellite telemetry, it is known that females that nest in Central America use Ecuadorian waters to feed and as a migratory route during their non-reproductive years. Several anecdotical reports of leatherbacks nesting along the coast do exist, and for several beaches. Machalilla National Park (MNP) is the only coastal National Park in continental Ecuador. It is in south-central Ecuador, and it is the nesting ground for at least three sea turtle species: olive ridley (*Lepidochelys olivacea*), green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*)); there are anecdotical reports of leatherbacks in the area, and one nest registered by Equilibrio Azul in the adjacent town of Puerto López in 2017. La Playita de Salango (La Playita) is a small, 800m long white sand beach located within MNP. It is an index nesting beach for hawksbill sea turtles and the host of the three nesting species from MNP, making it the most important beach of the area. Equilibrio Azul has been monitoring La Playita since 2007, when hawksbill nesting was confirmed, every night during the nesting season that last from November-May of every year. In the 2020-2021 season we registered for the first-time leatherback nests at La Playita. Four leatherback nests were registered and confirmed upon excavation after they hatched; all of them hatched successfully with hatching success ranging from 53 – 90.5%. This is the first confirmed record of leatherback nesting within Machalilla National Park (MNP). Furthermore, it is the first time in 13 years of monitoring La Playita within MNP that a leatherback nest is registered, making this beach a nesting ground for the four species of sea turtles that nest in Ecuador. It is also one the first records of successful hatching events for this species in the continental coast, besides a couple of nests in the northern part of Manabí province, registered during the same nesting season by Fundación Contamos Contigo Ecuador. From the total 16 nests registered along the coast by different actors during the 2020-2021 nesting season, only eight, including the four found at La Playita were successful. Puerto Rico beach is located south of MNP, where one track was registered during season 2020-2021 and six nests were registered during season 2021-2022, none of the nests were successful unfortunately, but we were able to tag and collect skin samples from one of the females.

INCUBATION DURATION AND VIABILITY OF LATE-SEASON SEA TURTLE NESTS ON THE EAST-CENTRAL FLORIDA COAST, USA

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Though sea turtle nesting on Florida’s east coast extends nearly year-round, nests laid in the last months of the loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*) nesting season, especially after the official “end” of the season (October 31), are historically understudied. Late-season nests are the most likely to be impacted by beach renourishment projects typically occurring from November-March. These nests are also exposed to lower temperatures, which will slow egg incubation duration and may reduce nest viability and hatching success. With the recent increase in green turtle nesting in Florida, it is likely that late-season nests will become more common and may have an important contribution to population dynamics. The beaches monitored by the University of Central Florida’s Marine Turtle Research Group (UCF MTRG) in south and central Brevard County are representative of nesting in the state, hosting about

1 in 6 loggerhead and 1 in 3 green turtle nests, making this an optimal study area. In 2021 and 2022, the UCF MTRG supplemented its reproductive sampling scheme to include more late-season nests. In 2021, a total of 9 loggerhead and 70 green turtle nests were marked during September-November, comprising 2% and 18% of total marked nests in 2021, respectively. During 29 August- 3 November 2022, 8 loggerhead and 67 green turtle nests were marked, with nesting surveys still ongoing. Inventory data collected from these late-season marked nests was used to describe incubation duration, viability, and reproductive success by species, compared to main season (April-August) nests. Assessments of 2021 nests show late-season nests incubated more slowly and were more susceptible to being washed out compared to those laid earlier in the season. Nests laid during August-September 2022 were heavily impacted by Hurricane Ian, and are still being assessed. Results from this research will be useful for determining the contributions of late-season nests to reproductive output, as well as informing nest inventory protocols during cooler months and aiding managers overseeing beach construction and seasonal beach restrictions.

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*GREEN TURTLE (I`A SA) NESTING ABUNDANCE, HATCHLING PRODUCTION, AND MOVEMENT BEHAVIOR IN THE CENTRAL SOUTH PACIFIC OCEAN: ROSE ATOLL NATIONAL WILDLIFE REFUGE (MULIĀVA OR MOTU O MANU), 2012-2019

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Sea turtles are a taxon of conservation concern and are highly migratory, exposing them to a variety of threats (bycatch, poaching, etc.) across their lifetime. Understanding the abundance of nesting females, hatchling production, and migratory movements represent three of the most basic biological data needs for this species group. This study summarizes novel data relevant to population assessments of the endangered Central South Pacific green turtle (*Chelonia mydas*) population, with a focus on analyzing annual rapid assessment surveys and satellite telemetry at Rose Atoll, American Samoa, between 2012 and 2019. A minimum of 138 to 221 females nested in the Rose Atoll National Wildlife Refuge (RANWR) over the study period; 221 is the most likely estimate given the low probability of recapturing individuals. Satellite tracks of post-nesting females suggest Fiji (n = 33, 68.8%) is the primary foraging ground for turtles nesting at RANWR, though other areas throughout the South Pacific Ocean are also important. Hatchling production was generally high (overall average hatching success of 92.6%) and nest temperature data collected between 2017-2019 suggest primary sex ratios were essentially balanced during this time. These are positive signs for the resilience of this nesting population, but climate change poses real threats to RANWR and other low-lying tropical islands throughout the CSP, particularly with respect to habitat alterations and hatchling production.

EFFICACY OF THREE CONSERVATION STRATEGIES EMPLOYED FOR PROTECTING GREEN TURTLE (*CHELONIA MYDAS*) NESTS AT PLAYA TRES AND PARISMINA BEACH, CARIBBEAN OF COSTA RICA

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The beaches in Caribbean coast of Costa Rica receive an important sea turtle nesting activity. Tortuguero National Park (TNP) protects the most important nesting beach for green turtles in the Atlantic. The 12-km stretch of beach south of TNP between the Jalova and Parismina river mouths (Playa Tres) and between the Parismina river mouth and the Pearl Lagoon (Parismina beach), receive over 1,000 green turtle nests annually. Illegal harvest of sea turtle products, such as meat and eggs, for human consumption is common in this area. Thus, it is important to employ conservation strategies to mitigate impacts of illegal harvesting on the annual production of sea turtle hatchlings in these areas. The objective of this study was to compare hatching success of three different methods of sea turtle nest management used at Playa Tres and Parismina in 2022. In Parismina, we relocated 121 nests to a hatchery, which was supposed to be watched 24/7. We also camouflaged and marked 30 *in situ* nests at Playa Tres and 4 at Parismina beach, moving sand over the body pit to hide the location of the egg clutch. At Playa Tres, we relocated 128 nests onto the beach at most 8 hours after oviposition. Finally, all nests were excavated to assess hatching success after signs of hatching were evident or after 70 days of incubation. 1- At the hatchery, we found an 80% hatching success. Four percent of these nests were stolen. 2- For *in situ* nests, we found an 86% hatching success. Thirty-five percent of these nests were stolen. 3- For relocated nests, we found a 76% hatching success. Six percent of these nests were stolen. The most effective method for increasing the hatching success of sea turtle nests at our monitoring areas is the hatchery. However, the drawbacks of this method include the need to walk long distances carrying egg clutches, which damage the eggs. Additionally, it requires intensive work in preparation for the nesting season as well as a constant supervision. After that, relocating eggs to the beach was the second most effective method of managing sea turtle nests at our monitoring area. The drawbacks of this method include the need for extensive human power to relocate the 50+ nests that can be laid in Parismina and Playa Tres in one night of the season. Additionally, people can follow researchers' footprints to find egg clutches. Consequently, researchers relocating and marking nests should be careful and erase their prints afterwards. Finally, the less invasive method is to leave nests *in situ*, which yield the highest hatching success. Unfortunately, this method also presented the highest rates of illegal harvest. Summing, increasing protection of the sea turtle nesting beaches so nests can incubate naturally is the best option for increasing hatching success. However, as illegal harvest of sea turtle eggs poses a threat to sea turtle nests in our monitoring area, both nest relocation to the nesting beach and to a hatchery are justified conservation strategies to ensure the highest production of hatchlings.

SEA TURTLE NESTING SEASON MONITORING BETWEEN PIEDRAS RIVER TO DON DIEGO RIVER, MAGDALENA, COLOMBIA

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In the Colombian Caribbean has been reported the nesting of *Eretmochelys imbricata*, *Chelonia mydas*, *Caretta caretta* and *Dermochelys coriacea*, being cataloged as vulnerable species resulting from human activities and natural events, in Colombia they are classified in the threat categories: In Danger and Critical Danger according to the Red Book of Reptiles. Within the efforts that promote the conservation of this reptiles, the SeaTurtle and Marine Mammal Conservation Program - ProCTMM, with the support of community technicians who are part of the fishing communities, have monitored from Piedras River to Don Diego River. Taking night and day walks along the coastline, recording events that include traces tracking, nest management and interception of nesting females, where the individual intercepted is marked, checked and measured their morphometric sizes. In addition to patrolling, efforts have been made to standardize a methodology for nesting beach environmental characterization, in geomorphological, edaphic, oceanometeorological, biological and anthropogenic aspects. The results of 9 non-consecutive years of monitoring of the nesting season in this area are presented, registering 152 reports of the species *C. caretta*, *D. coriacea* and *E. imbricata*, including 26 tracks, 116 nests, 2 sightings in water, and 8 intercepted females, it should be noted that in 14 years that the ProCTMM has monitored, no reports of *Chelonia mydas* nesting have been obtained. Although reports of nesting in the study area have decreased considerably since the 1970s, where around 300 nests per season were recorded only for *C. caretta*, thus it is still essential to continue monitoring the nesting beaches to continue the conservation of this species in this area.

HAWKSBILL SEA TURTLE HATCHERY MANAGEMENT

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Sea turtle hatchery management need not only follow a set of standardized "rules and guidelines." Effective hatchery management requires a contextualized understanding of the environmental setting where the hatchery is located. Since 2015, ProCosta has managed between four and five hatcheries on three different beaches in El Salvador. Through this process we have been able to improve our techniques to guarantee better management in our hatcheries. During this time, we have systematized the collection of data of several variable withing some of those we have temperature, the time it takes to relocate nests, how the nest is transported, etc. This information allowed us to modify the protocols to maintain the most optimal conditions of the hatchery. But not only do we monitor these parameters related to the nest itself, but we also consider aspects of hatchery construction and its surroundings. Among some of these we have the vegetation around the shed, the shape of the roof, the construction of barriers to protect the hatchery from the tides, etc. The set of all these variables make each nesting site distinctive and unique. In addition, we learn and consider the internal functioning of the community where we develop projects. We try to establish a bond with them so we can work together and learn from their needs and strengths with the purpose to better calibrate our goals according to the social reality of each community. No community is the same, so

it is important to learn from each site to guide the project effectively. We intend to share our collection of experiences so that new projects can start from empirical knowledge and compare and adapt what is useful to them under the individual conditions of each project.

HAWKSBILL, GREEN TURTLE AND LEATHERBACKS NESTING ABUNDANCE TRENDS AT SOUTH OF PUERTO RICO. GUANICA TO GUAYAMA

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Tortugueros del Sur Inc. Main purpose and mission is the protection, preservation, conservation and restoration of sea turtles, and their habitat in the south of the island of Puerto Rico. Sea turtle nesting surveys at the south coast of mainland Puerto Rico have been conducted since 2017. Approximately, 32 beaches from the municipalities of Guayama to Guánica are monitored. Hawksbills, leatherbacks, and green turtles have been reported nesting at these beaches. Nest totals are 1,463 for hawksbill, 104 nests for green turtles and 279 leatherback nests to this date. A total of 184 hawksbills nests and 48 green turtles' nests were reported at Pozuelo Beach, Guayama. The maximum number of leatherbacks nests counted in the south beaches was 64 nests. Most of the nesting occurred at Playa Ballena in Guánica. From all the nesting beaches we surveyed, Pozuelo Beach at Guayama had the higher number of nests for hawksbills and green turtles. The average hatchling success estimated was 79.4% for hawksbills, 80.1% greens and 39.1% leatherbacks. The major threats of these nesting colonies are light pollution, predation from exotic animals (stray dogs and mongoose), habitat degradation by loss of vegetation, and natural impacts such as storms, hurricanes and sargassum influx. We are implementing management actions to decrease these threats. Some of these actions are trapping mongoose, involving properties in a turtle-friendly retrofit program, and beach clean ups to minimize the impact of sargassum.

NEST SITE FIDELITY OF GREEN TURTLES, *CHELONIA MYDAS*, TO IDENTIFY PREFERRED NESTING LOCATIONS IN THE CAYMAN ISLANDS

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In 2013, the Cayman Islands Department of Environment started a tagging programme to monitor individual nesting female green turtles in Grand Cayman. A total of 130 green turtles were tagged between 2013 and 2022. Nest site fidelity (NSF) was determined using GIS analysis of high-resolution GPS coordinates of nests and false crawls. Within-season NSF was defined as the mean distance between all activities within the same season for the same nesting female. Multi-season NSF was defined as the mean distance between all observed nests from the same individuals that nested in either two, three or four different seasons. In addition, as previous research has showed a contribution of captive raised green turtles released from the Cayman Turtle Centre (CTC) into the wild population, the distance of nesting events from the CTC was also evaluated. Green turtles laid an average of 6.2 nests/season and had an average period of 9.5 days between each nest. Mean (± SD) within-season NSF was 0.40 km ± 0.84 (n=97) with 63% of all females nesting within 0.25 km and was higher if only nests (i.e. false crawls excluded) were taken into account (0.39 km ± 0.89; n=79). Multi-season NSF was 0.81 km ± 0.95 (n=53) with 28% nesting within 0.25 km for females observed in two seasons; 0.63 km ± 0.97 (n=22), with 55% nesting within 0.25 km for females observed in three seasons and; 0.44 km ± 0.43 (n=5) with 40% nesting within 0.25 km for females observed in four nesting seasons. Additionally, we found that beaches within 3.5 km of the CTC encompass the 62% of all the green turtle nests from 1999 to 2022, while comprising 10% of total nesting habitat. NSF is a useful tool for predicting future nesting locations and for identification of those small stretches of beach where individual turtles show multi-season fidelity. NSF data is of great importance for targeting efforts to control poaching and introduce turtle friendly development in the Cayman Islands and worldwide.

PACUARE RESERVE: MORE THAN 3 DECADES OF CONSERVATION OF LEATHERBACKS, RESULTS AND LEARNED LESSONS

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The Pacuare Reserve (PR) was founded in 1989 and gifted to Ecology Project International (EPI), a U.S.-based nonprofit, in 2016, to steward in perpetuity. 60% of the land is under a governmental tenure (created by the state in 1973 as Matina Pacuare Forest Reserve) and the other portion under private protection (and named as PR since 1989), but 100% of the land is administrated by Ecology Project International, it covers 2000 acres (800 hectares) of land and 3,7 miles (6 kilometers) of beach in the alluvial plains of the Caribbean slope of Costa Rica, in the county of Matina, Limon Province. Sea turtles are one of the most difficult species to monitor and protect due to their life cycle, as they spend over 90% of their lives in the ocean. Most practices used to assess species trends are implemented on nesting beaches. Pacuare Reserve has been protecting four different sea turtle species and receives hundreds of students annually who assist with gathering data to assess each species' conservation status, primarily on the leatherback sea turtle (*Dermochelys coriacea*). Since 1990 the main activity of the PR is the monitoring and protection of the second world's largest nesting population of leatherback sea turtle (*Dermochelys coriacea*) along the 3,7 miles of beach. The nesting season is between February and August, being the peak of the nesting season during April and May. Pacuare Reserve receives an average of 548 leatherback sea turtle nests per year, making it the fifth most important nesting beach for this species worldwide. Since 1989, administrators have been working diligently to protect adult females during the nesting process, their eggs (along the beach and in hatcheries) and hatchlings to make it to the sea. Pacuare Reserve collects data on nesting females each season, protects nests through relocation and conducts environmental education with student groups. Hatching success was analyzed as an indicator of nest management decisions. From 1994 to 2022, leatherback nests were either left in situ, relocated along the beach, or relocated to hatcheries (since 2018). Before 2014, hatchling success on natural nest were higher than any other treatment, but, after 2015, that percentage is decreasing, for the 2022 season, natural nest produces only 16% hatchlings, in counterpart of the 78% reported on hatcheries. The presence of guards and night censuses conducted by research assistants and students has reduced poaching from 98% of nests to only 0,7% after the first year --today, that rate is only 0.7%, the harvest or exploitation of sea turtles (for meat) decreases to cero since 2007, more than 23 000 different females has been tagged, more than 1,5 million eggs have been saved and more than 750 000 hatchlings has been released to the sea. There is new data about growing rates of Leatherback adult females, changes on quantity of normal and yolkless eggs through the time (per female), external tag retention, recovering from injuries, migratory panthers between nesting and feeding areas and remigration frequency.

SOME OBSERVATIONS OF GREEN SEA TURTLE NESTING CHARACTERISTICS IN A BEACH OF THE GULF OF MEXICO

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Nesting data for the green sea turtle (*Chelonia mydas*) is presented over 2022 nesting season from Centro Veracruzano de Investigación y Conservación de la Tortuga Marina, Veracruz Mexico. Night walks were conducted along 15.5 km of coastline in the municipalities of Nautla and Vega de Alatorre. When the female was depositing the eggs, a craniocaudal physical examination was performed to evaluate abnormalities present in the body. In addition, the curved carapace length (CCL) was recorded, as well as the time of laying, clutch size, the incubation period, and hatching success were calculated. A total of 200 non-individualized nesting females were recorded during May to October. The CCL varied between 89 and 118 cm with an average of 102.7 ± 5.9 cm. A total of 190 nests were recorded between 23:50 and 07:50 h with an average at 06:21 h. The clutch size was 101 eggs on average with a range of 22 to 159 eggs. The incubation period averaged 52.2 days with a range of 46 to 64 days and hatching success was 83% overall. Fifty-seven females were detected with body abnormalities. The presence of epibionts was the highest incidence, followed by flipper amputation, scars suggestive of interactions with fisheries, cloacal obstruction and inflammation, and epithelial lesions. Of the total, 10 females did not complete the nesting process due to the absence of hind flippers and/or cloacal obstruction. This research provides basic information on green turtle nesting and the physical condition of the nesting individuals. Since northern Veracruz is an important nesting area in the Gulf of Mexico with more than 10,000 nests per year, it is recommended to continue monitoring the physical health of the females as it can serve as an indicator of the threats to which they are exposed in their nesting habitat.

*HISTORICAL RECORDS OF LOGGERHEAD TURTLE (*CARETTA CARETTA*) NESTING AT TORTUGUERO, COSTA RICA

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Costa Rica is considered a hotspot for biodiversity and wildlife conservation in Central America, sea turtles are a good example of this. Largely distributed along both the Caribbean and Pacific coast, adult females from five of the seven extant sea turtle species select beaches on both coasts of the country as their breeding sites. While globally endangered green turtles (*Chelonia mydas*), regionally endangered leatherback (*Dermochelys coriacea*), critically endangered hawksbill (*Eretmochelys imbricata*), and globally vulnerable olive ridley (*Lepidochelys olivacea*) have been extensively studied in Costa Rica, little information regarding the vulnerable loggerhead sea turtles (*Caretta caretta*) is available. Thus, we aimed to present an exhaustive data record of every loggerhead encountered over the past 60 years at Tortuguero beach, located in the Tortuguero National Park (TNP) on the North-East Caribbean coast of Costa Rica. We collected loggerhead encounter and nesting data between 1957-2021 through daytime surveys and nocturnal monitoring activities. We documented 14 loggerhead turtle nesting attempts between 1957-2021

at Tortuguero. Among them, seven nested successfully, four did not lay eggs and returned to the sea, and one record's fate was unknown. Additionally, two turtles' carcasses were found with evidence jaguar (*Panthera onca*) predation. Mean Curved Carapace Length (CCLmin) measurements for the found loggerheads was 98.2 ± 3.7 cm (range between 90.0 -101.4 cm). Most of the encounters were registered on the northmost 8 km of the Tortuguero beach, which is the most commonly monitored section of the beach at TNP. Finally, we found that every encounter occurred between April and July, which coincides with the loggerhead nesting season in the Northwest Atlantic. This study is the first assessment of loggerhead turtles nesting in Costa Rica, our findings show that loggerhead nesting numbers at Tortuguero are minimum when compared with larger loggerhead nesting assemblages like those of the east coast of Florida, which hosts one of the largest nesting colonies in the world. However, we bring to light new records of loggerhead nesting turtles in the Caribbean Sea highlighting the importance of data collection to improve appropriate conservation and management strategies to better understand and protect key areas for this nesting individuals in Central America. Additionally, this study corroborates the importance of Tortuguero as a major rookery for the conservation of different sea turtles nesting populations and the strategic role that Costa Rica plays in the protection of these threaten species.

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*EVALUATION OF THE EFFECTIVENESS OF SANDBAGS FOR THE INCUBATION OF CLUTCHES OF *LEPIDOCHELYS OLIVACEA*, IN THE PACIFIC COAST OF NICARAGUA

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Along the Pacific coast of Nicaragua, incubation of sea turtle eggs in hatcheries has increased; notably, in the last five years, many local turtle conservation projects have adopted the use of 100 or 200 litre sacks filled with sand to incubate egg clutches. This incubation technique differs from the more well-established practice of burying clutches into beach-based hatcheries sand floor (standard hatchery). Hatchery managers using the technique of incubation in sandbags claimed better hatchling emergence rates compared to the standard hatchery techniques; however, to the best of our knowledge no empirical studies exist to evaluate these observations. Between 2017-2019, three field experiments were conducted to compare the relative efficacy of sandbags versus standard hatchery techniques for the incubation of *Lepidochelys olivacea*. The experiments were conducted in two different locations in the Pacific Coast of Nicaragua: Veracruz and Juan Venado. Nests were relocated into a hatchery, and randomly assigned to treatment (in sandbags of 100 or 200l) or control (in the hatchery floor) within each triad (n=227). To compare the performance of treatment and controls, we measured nests' emersion rates, duration of incubation, hatchling morphometric (length, width, weight) and speed over a distance of new-born hatchlings (as a proxy for hatchling health). Temperature data loggers were deployed in a sub-sample of nests and the resulting temperature profiles across treatment and control were compared. For data analysis, OLS regression (Ordinary Least Squares) was used, controlling for clutch size, day of the relocation, and time of relocation. After the first nesting season, we concluded that 200-lit bags significantly outperformed the smaller 100-lit bags, in terms of hatching/emergence rates and hatching health, so it was decided to exclude the 100-lit bag condition from the rest of the experiment. No differences in the morphometric characteristics of hatchlings were found across treatments and controls. Preliminary analysis suggests that 200 lit bags produced a slightly, but not statistically significant, increase in emergence rate with respect to the standard hatchery. Incubation in 200-lit bags led to a statically significant increase (of five days) in the average incubation period and a statistically significant reduction in hatchling speed. With respect to the thermal profile of the different

incubation techniques, the fluctuation in daily thermal range was observed to be inversely proportional to the volume of the bags, with standard hatchery having substantially more stable temperatures than the bags. Our observations suggest that daily thermal fluctuations of sand in the bags may be increasing the incubation period and decreasing the speed of the resulting emergent hatchlings, which may indicate poorer hatchling health and lower post-emergence hatchlings survival. We suggest that the slight (non-statistically significant) increase in emergence rate produced by 200-lit bags is outweighed by the indications of poorer hatchling health. Additionally, variations in the thermal environment of egg clutches may have consequences on hatchling sex ratios that we still have to elucidate. Consequently, do not recommend the use of 100-lit or 200-lit sandbags as an alternative to the standard hatchery. In this presentation, we synthesize the results of this experiment for future steps.

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*HATCHING SUCCESS OF GREEN TURTLE (*CHELONIA MYDAS*) EGGS RECOVERED FROM FEMALES PREYED UPON BY JAGUARS (PANTHERA ONCA) AT TORTUGUERO NATIONAL PARK, COSTA RICA

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Tortuguero National Park (TNP), on the Caribbean coast of Costa Rica, is the most important Atlantic nesting beach for green turtles (*Chelonia mydas*), where approximately 100,000 green turtle nests are recorded annually. At TNP, jaguars (*Panthera onca*) prey upon hundreds of nesting sea turtles every year. Between June 2021 and October 2022, while conducting necropsies on green turtles killed by jaguars to study their reproductive physiology, we found that over 50% of females had shelled eggs in their oviducts at the time of death. To determine whether unlaid clutches are viable and evaluate potential methodologies for burial of recovered eggs, we assessed hatching success of 22 green turtle egg clutches under two burial treatments. During necropsy, we removed egg clutches from the oviducts of 22 female green turtles that had been depredated by jaguars. Nine clutches were placed in a bucket and buried directly after removal from the body cavity (unrinsed) and 13 clutches were placed in a bucket and rinsed in unfiltered sea water prior to burial (rinsed). All clutches were buried in the sand at 60 cm of depth, at the border of the vegetation close to the predation site, and within 12 hours of maternal death. We evaluated hatching success of recovered clutches using standard procedures and compared hatching success between unrinsed and rinsed treatments. We also compared these outcomes to results from 31 nests incubated *in situ* and 127 nests relocated within 12 hours of oviposition at a beach adjacent to TNP. Mean hatching success of recovered green turtle clutches was significantly lower than relocated and *in situ* nests. Hatching success of rinsed clutches was significantly higher than that of unrinsed clutches, though still significantly lower than that of *in situ* nests (91.3%) and nests relocated after oviposition (76.5%). Additionally, approximately 30% of unhatched eggs in rinsed clutches presented visible embryos, whereas only 5% of unhatched unrinsed eggs had visible embryos. Jaguars attack nesting green turtles by biting their necks, which usually severs the spinal column at the base of the skull, and gradually pulling organs and muscles out to eat. Rupture of the female sea turtle peritoneal membrane following jaguar attack may expose unlaid eggs to air, breaking embryonic arrest. If the vitelline membrane was already attached to the shell by the time eggs were recovered, this would have contributed to lower hatching success. Further, eggs recovered from depredated green turtles were invariably contaminated with blood and other body fluids, and these clutches may have been colonized by different, detrimental microbiota. In conclusion, egg clutches recovered from the body cavity of female sea turtles are viable for at least 12 hours after maternal death. Furthermore, hatching success is improved if these eggs are rinsed with sea water, rather than buried directly after recovery. The technique described in this study provides yet another sea turtle conservation tool to increase hatchling production.

NEST SHADING IMPLICATIONS ON THERMOSENSITIVE PERIOD, SEX RATIO, AND INCUBATION TIME AT RED SEA TURTLE ROOKERIES

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Sea turtles nest along the Red Sea and are regularly exposed to thermal extremes, with sand temperatures often exceeding lethal thresholds. Based on data from other regions, these conditions should lead to shorter incubation times, highly feminized sex ratios in hatchlings, and low overall nesting success. While Red Sea turtles may be specifically adapted for local temperature regimes, data from the region is scarce. Here, 21 HOBO temperature loggers and 21 HOBO movement loggers were deployed within 21 relocated nests during the 2022 nesting season at Ras Baridi, the largest green sea turtle (*Chelonia mydas*) rookery on the Red Sea. Seven nests were incubated under natural conditions while fourteen were shaded using two common methods (palm fronds and white surface sand) in an effort to increase incubation times and decrease sand temperatures. Nests were monitored at 50 days for hatching and the date that individuals emerged was recorded. At 80 days all nests were excavated and the movement and temperature loggers were retrieved. We modelled the nests using incubation times derived from both times of emergence and the pipping data retrieved by the movement loggers. We anticipate being able to compare the different method's estimates of total incubation time, resulting delineations of the thermosensitive period, and modelled sex ratios for both shaded and unshaded nests. These results could demonstrate regional adaptation to high temperatures in Red Sea green turtles and quantify the effectiveness of shading interventions in this region.

THE IMPACTS OF NEST TEMPERATURES ON LEATHERBACK (*DERMOCHELYS CORIACEA*) HATCHLING MORPHOLOGY AND PERFORMANCE

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Leatherback sea turtles are experiencing population declines due to various natural and anthropogenic threats. The beach plays a crucial role in the survival of sea turtle species since reproductive success is related to environmental factors including nest temperature, moisture levels, and gas exchange through the sand. Climate change is predicted to increase soil temperatures and affect rainfall, which will change the nest microenvironment, and thus may alter not only hatch and emergence success but also hatchling morphology and performance. This study examined the relationship between nest incubation temperatures and leatherback (*Dermochelys coriacea*) sea turtle hatchling terrestrial performance, as the crawl from the nest to the sea is a critical phase of hatchling survival. Temperature data loggers were placed in 13 leatherback sea turtle nests in Juno Beach, Florida, USA on the day they were laid across the early, middle, and late South Florida nesting season. Upon emergence, hatchlings were tested for righting ability and crawling speeds. An inventory of the nests was conducted three days after the initial emergence to determine hatching and emergence success. Mean nest temperatures ranged from 29.0°C-32.5°C and were significantly higher in the mid- and later season nests than early nests. Hatching and emergence success correlated with temperature, where the mid – season nests were the most successful. Hatchling morphology

also correlated with temperature; lower nest temperatures produced larger hatchlings than nests with hotter temperatures. Nest temperatures were not correlated with any differences in crawling speed, though righting response scores were significantly lower in hatchlings from late season, hotter nests. The study results will allow for a better understanding of how rising nest temperatures may impact hatchling performance and in turn affect their survival.

ESTIMATING THE SEX RATIO OF HATCHLING LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) IN BOCAS DEL TORO, PANAMA

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Species that exhibit temperature-dependent sex determination, such as marine turtles, are posed with a significant threat as global temperatures rise due to climate change. Rising global temperatures threaten to feminize marine turtle populations, which may impact the ability of these ancient reptiles to reproduce. Knowledge of the baseline sex ratio for marine turtle populations is essential to support ongoing management and conservation efforts. The global leatherback sea turtle (*Dermochelys coriacea*) population is currently listed as vulnerable, yet information on baseline sex ratios of many important rookeries is lacking. Here we present the first baseline study of sex ratio for an important rookery for *D. coriacea* in the Caribbean at Playa Soropta in Panama. Dataloggers were deployed in the center of the clutch and recorded temperature hourly. A small subset of nests contained 4 dataloggers located at the top, middle, bottom, and lateral positions of the nest to analyze thermal variation across the clutch. Nest temperatures indicated a slight female bias in the sex ratio of *D. coriacea* hatchlings at Playa Soropta. Multiple dataloggers showed negligible within-clutch variation of temperature throughout the incubation period. Due to high levels of poaching, a hatchery was started for the 2022 nesting season at Playa Soropta. In comparison to nests from the natural beach, hatchery nests experienced slightly higher incubation temperatures. Further research including inter-annual sex ratios are necessary to confirm these results and monitor this population over extended time scales. Nevertheless, results from this study provide important insights to inform future beach management decisions and hatchery implementations in Panama.

RECURRENT PREDATION OF SEA TURTLE EGGS BY MONITOR LIZARDS (*VARANUS NILOTUCUS*) AT A NESTING SITE ON BIOKO ISLAND, EQUATORIAL GUINEA

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Bioko Island's southern beaches are important nesting site for sea turtles in the Gulf of Guinea region. In this study we report on the predation of sea turtle eggs by monitor lizards (*Varanus nilotucus*) at a turtle nesting site on Bioko Island, Equatorial Guinea. We used a combination of visual sampling surveys and camera trap video captures in order to provide insight into predatory threats for sea turtle nests at a remote turtle nesting site with no history of regular human presence. We monitored a 0.6 km long nesting beach for threats to the three sea turtle species (leatherback (*Dermochelys coriacea*); green (*Chelonia mydas*); olive ridley (*Lepidochelys olivacea*)), that used this beach for nesting. We found that monitor lizards were a regular culprit to dig up sea turtle nests. Surveys showed that monitor lizards would walk on the beach almost daily during the nesting season to search for fresh sea turtle nests. Upon digging up a nest, they would return to feed for up to 10 days, along with up to 8 other species of animals who fed on the eggs opportunistically. Thus, monitor lizards may feed regularly on sea turtle eggs during times when nesting abundance is high. While more information on monitor lizard diet is required to determine how important sea turtle eggs are to their diet, our results support the idea that they specifically target turtle eggs during the nesting season.

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*21 YEARS OF POLYSTYRENE BOX INCUBATION RECORDS: WHAT DO THEY TELL US ABOUT THE HUMAN ELEMENT IN EX SITU MANAGEMENT OF SEA TURTLE EGGS?

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Ambient factors such as sand temperature, moisture, and gas exchange are known to influence sea turtle hatching success during incubation. Our study focuses on how management interventions such as *ex situ* incubation can also affect productivity. The government-permitted Grupo Ecológico de la Costa Verde project at San Pancho, Nayarit, Mexico has moved over 13,000 turtle nests since 1991 in order to protect them from poaching, predation, and tidal inundation. When relocation on the beach is not possible, turtle eggs and moistened sand are packed into polystyrene boxes which are kept in a greenhouse-type hatchery until release to the sea. Olive ridley hatchling success with this technique has been relatively high (mean 84.8%, SD 4.4%) compared to their beach hatchery method (58.4%, SD 20.3%) and other projects' success with boxes. To inform future management decisions and hatchery practices we explored how hatching success of close to 10,000 nest boxes varied with parameters involving human decisions recorded in the database. These factors were days in the box, box type, density of eggs, placement of box (cardinal direction), and volunteer experience. Our generalized linear model showed that hatching success was only influenced by the number of days left in the box between hatching and release. It is likely that once nest temperature and moisture data are added to the model, human decisions could play a larger role in the predictive model. Careful review of the data show that after six days of retention, release success declined by 22.3% rather than improved. After a volunteer had packed over1,600 nest boxes, their release success only improved by 0.81%. A 27-inch tall, 1-inch-thick Styrofoam box outperformed taller, thicker boxes by 2%. In this nursery, one corner (NE) had significantly higher hatching success than the other five regions. Only the most densely packed boxes showed significantly lower success. Our conclusions are that for this nursery it is a better use of effort and funds to scientifically monitor the nest conditions rather than track the human element. Yet lessons learned from the detailed management records kept at San Pancho have the potential to help nesting projects around the world that may be forced to convert to *ex situ*methods as climate change continues to result in higher sea levels, sand temperatures, and more frequent and intense storms on the nesting beaches.

DOES PREDATION PRESSURE ALTER NATURAL HATCHLING SEX RATIOS ON FETHIYE BEACHES, TÜRKIYE?

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Temperature dependent sex determination (TSD) is a well-known phenomenon in sea turtles. High temperatures during incubation are known to produce female hatchlings. Studies carried out so far in the Mediterranean have shown that most of the nesting beaches are producing female-biased hatchling. Fethiye nesting beaches in Türkiye, are the loggerhead sea turtle (*Caretta caretta*) nesting site and are known to produce relatively high ratio of male hatchlings in the Mediterranean. However, an increasing predation pressure has been observed in Fethiye nesting beaches in recent years. In this study, the effect of predation on offspring sex ratios in Fethiye beaches was investigated. Temperature recording devices were placed in 17 of 103 nests observed in 2022 and female-male ratios were estimated. Nesting beaches were examined by dividing into three sub-sections (Akgöl, Yanıklar and Çalış), and predation pressure as well as female to male production rates of the regions were analyzed. Among all three sub-regions, the best-preserved area with its natural structure was Yanıklar Beach. The female to male hatchling ratio was calculated as 2.5:1 across Fethiye Beaches, which is lower than the male hatchling ratios previously reported from this region. Although there was no statistical difference between the sub-regions in terms of sex ratios, the highest number of male offspring was produced (2:1) on Yanıklar Beach. However, 49.1% of the nests were predated on this beach. Predation was not observed on Akgöl beach where the male hatchling production was lower than Yanıklar beach (2.8:1), and on Çalış beach where the male hatchling ratio was the lowest (3.9:1). Our preliminary observations suggest that increased predation pressure in the best-protected sub-section in the region increases the pressure on sea turtle nests, as the range movement of predators was limited to the protected area due to increased human activities in nearby areas. This may adversely affect natural sex ratios of hatchlings at the Fethiye beaches in the long-term. This preliminary result showed that protecting a nesting beach alone will not be sufficient for species protection and that the relations with other taxa should be well monitored and conservation measures should be arranged according to these relationships.

*SANDY POINT FORTY YEARS ON: EMERGING HOTSPOT FOR THREE SEA TURTLE SPECIES

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Since 1977, research and monitoring of sea turtles has occurred at Sandy Point National Wildlife Refuge, St. Croix, US Virgin Islands. Managed by different entities and supported by thousands of volunteers over the years, it has been managed by the US Fish and Wildlife Service, as a wildlife refuge since 1983. Sandy Point is most famous for its leatherback project, but unfortunately the numbers of nests and females have been declining rapidly since 2009 (59 nests and 20 females in 2022). However, two other species (green and hawksbill turtles) use Sandy Point and have for decades. As the pandemic interrupted most human activity and more time was spent in the field, we had an opportunity to evaluate all three species in the refuge as well as on beaches outside the refuge. We began satellite tracking Sandy Point leatherbacks during the pandemic to investigate movement among nesting beaches in the region. With 18 transmitters deployed, we found that leatherbacks are choosing multiple beaches within seasons (from Puerto Rico to Antigua) but that their clutch frequency overall is declining. This has implications for population life history parameters and for evaluating recovery. There have been surprising and encouraging gains in the number of green turtle nests since 2003 within the refuge and across St. Croix. With more than 1,000 nests per year (as high as 1,700 nests in 2020), nesting numbers for green turtles across St. Croix may rival other large rookeries in the Caribbean, easily surpassing the number of nests found in Puerto Rico and surrounding islands. We take this opportunity to elevate the status of St. Croix as critically important habitat for three species of sea turtle and as another important consistent high-density site in the Caribbean for hawksbill turtles (apart from Buck Island, St. Croix) under US jurisdiction. Mark recapture of all three species is ongoing, the longest tag return for leatherbacks is 31 years, for hawksbills 25 years, and for greens, 20 years. Our goal is to continue to characterize these population and evaluate threats within their respective Regional Management Units (RMUs).

CONSERVATION PROBLEMS IN UNDETECTED LOGGERHEAD SEA TURTLE NESTS IN SPAIN

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The loggerhead sea turtle is expanding its nesting range in the Mediterranean throughout the western basin, particularly in Italy and, in lesser numbers, in Spain, in what seems a colonisation process. The Spain's Mediterranean coasts have seen an increasing trend of nesting events in the last decade, with a slight decrease in 2022 probably due to stochastic biotic and abiotic factors. Although sporadic successful nesting events have been recorded in Spain since 2001, nests laid in 2014 caught the attention of sea turtle researchers and authorities. Since then, awareness campaigns and conservation and management activities, including beach patrolling, are allowing the detection of successful and failed nesting events, mostly in urban/tourist beaches. When detected, current regional and national protocols lead to many actions for clutch protection. Human activities were the main cause of failure in nesting. The many unsuccessful events recorded may indicate that turtles are nesting elsewhere, in natural-non visited beaches, and go undetected. Undetected nests remain unprotected and may suffer from different threat compromising their success. Here we analyse three recent cases of nests not detected when the female was nesting that suffered from important natural and anthropogenic threats: 1) In September 2020, two hatchlings were detected crawling by an isolated gray sand beach at Calnegre, Murcia (Southeast Spain). The beach was accessible only by foot in an isolated area. After finding the nest, clutch study yielded only 10,1% hatching success rate, with 73 eggs dead in a very early state probably due to overheating. Beach characteristics seemed not very suitable for embryo development. Clutch relocation to a more suitable beach would have been a potential solution to increase hatching success. 2) In September 2021, hatchlings were reported crawling by the beach promenade, attracted by beach lights, at El Puig, Valencia (East Spain). A total of 15 hatchlings were rescued and moved to the rescue centre for a head-starting program, although one did not survive. Nest study yielded 58.3% hatchling success rate (70 out of 120 eggs); hence it is impossible to know how many hatchlings reached the sea or were lost. Early detection leading to clutch protection or relocation to a protected beach would have benefited hatchling's protection. 3) In September 2022, eggs shells were detected around a possible nest in an isolated beach at Burriana, Castellón (East Spain). As in case 1, beach was not very suitable for embryo development, leading the turtle to lay the eggs shallow. Evidence found indicated that the clutch was fully predated by canids, either feral dogs or foxes. This is the first record of loggerhead clutch predation in Spain. These three cases show that, despite the awareness campaigns and the efforts of researchers, volunteer monitoring programs and authorities, not all nesting events occurring in Spain are detected. These cases also reveal the need of conservation measures, including control of light pollution and clutch relocation, to protect clutches and therefore to help in the colonization process and the establishment of the Spanish Mediterranean as a stable nesting area for the species.

HAWKSBILL (*ERETMOCHELYS IMBRICATA*) NESTING HABITAT CHOICE AT SANDY POINT NATIONAL WILDLIFE REFUGE, ST. CROIX, VI.

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The makeup of Sandy Point National Wildlife Refuge constitutes suitable nesting habitat for three species of sea turtle: *Eretmochelys imbricata*, *Dermochelys coriacea,* and *Chelonia mydas* and is one of the most densely nested beaches in the Caribbean. Nesting hawksbill turtles (*Eretmochelys imbricata*) lay their eggs under a variety of coastal bushes, shrubs, and trees at Sandy Point. Hawksbill habitat choice is likely driven by abundance of botanical species. Although it's known that hawksbills nest in coastal forests often dominated by sea grape (*Coccoloba uvifera*), more study is needed to understand habitat preference of nesting turtles at Sandy Point National Wildlife Refuge. We have been recording the flora that hawksbills choose to nest under since 1982. Surveys were done of the North, West and South beaches of Sandy Point in order to better understand the types of habitats that turtles choose. We assessed 1,649 nests and noted observations on vegetation. Not all activities were associated with vegetation by the observer; as a result we have habitat data for approximately 600 of the recorded activities. We found that hawksbills nesting at Sandy Point lay their eggs under a variety of bushes in the dense coastal forest, as well as small bushes and shrubs closer to the water on the open beach. On rare occasions they were found nesting on the open beach under no bushes or trees. In our preliminary analysis, the plant our turtles nested under most commonly was sea grape (55%). In order to restore nesting habitat for hawksbill turtles around the Virgin Islands we recommend planting sea grape as well as mahoe, bay lavender, and bay cedar. We recommend that more precise data on vegetation be gathered in the future.

*INSIGHTS INTO NESTING ECOLOGY OF MARINE TURTLE POPULATIONS UNDER CONSERVATION: TWO DECADES OF MONITORING IN KENYA

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Marine turtle nesting on the continental coast of east Africa, and associated data used to assess population status, are scarce relative to the Western Indian Ocean (WIO) islands. Here, we present results from the long-term (2000-2020) monitoring program in and around the Watamu National Marine Park (WMNP), Kenya. We outline how the conservation actions undertaken by a grassroots community-based organisation have resulted in a near-total cessation of the illegal take of adult females and their eggs in the WMNP. The organisation, Local Ocean Conservation (LOC), recruited members from the local communities around

Watamu and built capacity using internationally recognised turtle conservation and monitoring protocols. The data that LOC has collected make the WMNP an important index site for marine turtle monitoring and ecology for Kenya and the WIO region. Green turtle *Chelonia mydas* nests were most common (95%, n = 920), followed by olive ridley *Lepidochelys olivacea* (4%, n = 41), with occasional nests by hawksbill *Eretmochelys imbricata* (n = 2) and leatherback turtles *Dermochelys coriacea* (n = 1). Numbers of clutches laid per season increased significantly over the 20-year monitoring period for green turtles (50%) and showed a positive trend for olive ridley turtles. Important parameters for effective population assessment and management, such as clutch frequency, remigration intervals, internesting intervals, and female size are presented. The span of the conservation efforts, combined with the annual increase in clutches and possible decrease in female size, strongly indicates that this population may be recovering as the proportion of primiparous females in the population increases. Nest relocations, which are conducted by LOC only when there is a severe risk to the nest such as illegal take of the eggs or repeated tidal inundation, were found to be an effective conservation strategy with >80% average hatching success rate. The Watamu rookery does, however, remain at risk from human pressures. Coastal development, mainly for tourism, increased substantially in and around Watamu since the 1970s. As a result, footfall, noise, and light pollution on the beaches have increased and sections have become unsuitable for nesting due to the construction of coastal defences. Clutch distribution along the WMNP beach has transposed towards the south-central section, potentially resulting from anthropogenic development and disturbance. Only two incidences of illegal take of eggs were along the WMNP beach in 20 years, but mortality from intentional (e.g., illegal take of eggs and adults) and incidental (e.g., fisheries bycatch) processes are still common to the north and south of the WMNP. Given the small size of the nesting cohorts, the removal of even a single gravid individual will have a considerable impact on productivity. The pressures outlined here have likely slowed the growth rate of the Watamu rookery. We suggest future directions of research that will further contextualize this site nationally and regionally, such as making use of genetics and satellite telemetry. Continued and expanded private and governmental conservation efforts and engagement with coastal stakeholders are needed to elevate continental rookeries to levels seen elsewhere in the WIO region.

LOGGERHEAD SEA TURTLES NESTING ON ARUBA 2001-2022

Sietske van der Wal, Edith van der Wal, and Richard van der Wal

Turtugaruba Foundation

For many years nesting of Loggerhead Sea turtles, *Caretta caretta*, was thought to be extremely rare in Aruba. There were only three nests reported before 1993. Triggered by opportunistic findings since then, a monitoring program was set up and implemented since 2001. This program consists of early morning patrols, *in situ* nest protection and post-emergence excavation. Data from this monitoring program are presented here (2001-2022). The project started on five beaches, and it has expanded gradually as more reports came in from additional beaches. Since 2011, the loggerhead monitoring program is island wide and consistently comprises 14 beaches. Most of the nesting activity, 80%, is concentrated on three of these nesting beaches. The recorded *Loggerhead* nests in Aruba over the last 12 years (2011-2022) show an average of 23 (range: 14 - 42) nests per year. The average incubation period is 51.9 days (± 5 days) and the average hatching success is 74.5 %. The nesting habitat of *C. caretta* is vulnerable to several anthropogenic threats: habitat loss due to coastal development, including nocturnal human presence on beaches and (remote) artificial lights, off road driving and beach pollution. Turtugaruba Foundation, as a volunteer-based NGO, is unable to resolve all these threats at the source. However, some can be mitigated through resourceful interventions and the Loggerhead nests are protected one nest at a time. In addition to the standard monitoring of the nesting activity. Satellite tracking of four individuals has revealed connection of the Aruba nesters with feeding grounds near Nicaragua (3) and Colombia (1). The nesting female with the feeding ground near the Colombian coast returned within a year for another nesting season.

*SMALLER SIZE OF NESTING LOGGERHEAD FEMALES (*CARETTA CARETTA*) IN THE GULF OF MEXICO: EFFECTS ON NEST PLACEMENT AND PRODUCTIVITY

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Accurate demographic parameters are critical elements of population management for endangered species. Particularly, defining the minimum size at reproductive maturity (i.e., the transition between subadult and adult size classes) can have significant impacts on population recovery estimates and conservation management decisions. Recent studies have highlighted reductions in nesting sea turtles body size over the last 40 years and greater prevalence of undersized females across species with implications for hatchling production. To determine if this is relevant for nesting females at St. George Island, Florida, USA - the dominant nesting site in the Northern Gulf of Mexico Loggerhead Recovery Unit - we used a six-year tagging and nest monitoring dataset (2016 - 2022) to investigate 1) how this site aligns with previous studies across various sites in the Gulf of Mexico that have experienced declining trends in female size, and 2) how turtle size impacts nest placement, nesting success, and clutch size and disturbances. Nighttime tagging surveys were conducted during the peak of the nesting season (approximately the last two weeks of June) to identify and measure individual nesting females, whereas morning surveys were conducted throughout the nesting season (May to October) to report nest disturbances and evaluate hatchling production. Turtle size varied from 80.2cm to 109.1cm with a mean of 94.2cm ± 5.8cm SD. Out of 218 unique individuals, 22 (10.1%) fell below/were equal to the 87cm minimum curved carapace length (CCLmin) threshold adopted by the US National Marine Fisheries Service as the minimum size at maturity for loggerhead turtles, here termed the "undersized" size class. This percentage is identical to a similar study conducted at the western limit of this population. The prevalence of undersized turtles varied from year to year (4.2% - 15.9%), but this was not a significant predictor of the mean size ($p = 0.887$) nor the proportion of undersized individuals ($p = 0.796$). There appears to be a difference in nest placement by size class as undersized nesters tended to congregate closer to the island's center, whereas larger nesters mostly used the western extent. Nesting success was not significantly related to turtle size, nor were the rates of clutch predation, invasion by roots, wash-over, and hatching and emergence success. CCLmin, but not size class, did impact clutch size and rates of wash-out. Clutch sizes increased by approximately 1 egg per 1 cm increase in body size ($p = 0.001$) while wash-out rates increased by 0.53% over the same scale ($p = 0.03$). Though the largest turtles laid the largest clutches, these nests also had a greater probability of being washed-out, resulting in complete loss of the clutch, which may moderate overall hatchling production. However, these trends should be treated with caution due to limited sample sizes for undersized individuals. Additional understanding of how anthropogenic and/or environmental factors influence size and reproductive outputs, and what this reduced size means for population management, is needed. Notably, updated size class definitions for the species may enable better protection of each class.

*DODGING THE SURF: FACTORS BEHIND THE EXPOSURE AND TOLERANCE OF WAVE WASH-OVER FOR LOGGERHEAD TURTLE NESTS IN THE NORTHERN GULF OF MEXICO

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Exposure to wave wash-over, wave-induced erosion, and groundwater inundation are significant threats to incubating sea turtle eggs across species and nesting beaches. Previous monitoring and modeling efforts in the northern Gulf of Mexico have reported average exposure rates of ~40% of incubating loggerhead turtle (*Caretta caretta*) clutches with significant declines in hatchling production from affected nests, making wave and inundation exposure the dominant threat in the region. Before advocating for any particular management action, managers must address several critical knowledge gaps including the identification of environmental factors driving wave and inundation exposure as well as embryonic tolerances to this exposure, including lethal and non-lethal consequences. Daily morning nesting survey data from the Bon Secour National Wildlife Refuge in Gulf Shores, Alabama, USA from 2011 – 2021 (e.g., GPS coordinates, clutch evaluations, disturbance history) were combined with GIS analyses (e.g., LiDAR-based digital elevation models, distances to Mean Higher High Water (MHHW) and dune toe contours) to evaluate environmental and temporal covariates associated with wave exposure and describe the effects of exposure on hatchling production. Of the 234 nests available for analysis, 113 (48.3%) reported wave exposure at some point during their incubation including 34 (14.5%) which were lost to wave-induced erosion. Preliminary analyses suggest nest elevation, rather than distance from the MHHW contour, as a dominant physical driver of the probability of wave exposure as well as year and week deposited as significant temporal covariates. For each meter of elevation gain, probability of wash-over declined approximately 10%. From 2011 – 2021, the probability of wave exposure increased by approximately 5% per year and nests laid toward the end of the season were twice as likely to be washed over as those laid earlier. This pattern is due to the role of hurricanes as the primary source of exposure events as opposed to daily high tides. When wash-over did occur, many nests continued to produce viable hatchlings. Mean hatching success of washed over nests was 44% lower than undisturbed *in situ* nests, declined with increased wave exposure frequency, and approached 0% after 5 events. By comparison, nest predation (largely by ghost crabs *Ocypode quadrata*) resulted in only a 3% reduction in hatching success. Such multi-year analyses are critical to fill knowledge gaps currently hindering the conservation decision-making process for this threatened species. Additional analyses are underway as is the development of an online dashboard to assist managers in understanding the threat of wave exposure at local beaches.

*PREDATION OF LOGGERHEAD SEA TURTLE NESTS CAUSE A POTENTIAL EFFECT TO THE NEST SEX RATIO ON DALYAN BEACH, TÜRKİYE

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Dalyan beach, Mugla, Türkiye hosts one of the largest loggerhead nesting rookeries in the Eastern Mediterranean with a maximum nest number of 758. Nest temperatures provide an estimation of the sex ratios produced from nests. Nest predation by foxes and badgers were also another factor effecting the hatching success and therefore the potential sex ratio of the hatchlings produced. We have analysed the predation rates over the nests (n=438) together with the nest sex ratios in the nesting season of 2022. The predation rates of the nests were calculated as 61%. The majority of these predated nests (n=156) were completely predated and 42% of the nests (n=112) were partially predated. The nest temperatures (n=37) were measured via temperature data loggers and the mean temperatures during the middle third of the incubation period were used in sex ratio estimation. The sex ratios of the nests were all female dominated with a mean of 74%. Taking into consideration of the majority of the top eggs were potentially females that are likely predated. We have calculated the total number of eggs partly predated and remaining eggs that produced hatchlings. We have analysed both temporal pattern of the predation and potential effect of this to the sex ratio of hatchlings produced. There was heavy predation on the early nests that potentially producing more male hatchlings and there was also partial predation on top eggs that more likely to be females as partly predated. We developed a screening of both top and sides of the nests to mitigate the predation pressure. Such mitigation measurements are particularly important under the potential effect of climate change to feminisation of sea turtle population in the world.

POPULATION BIOLOGY AND MONITORING (STATUS, MODELING, DEMOGRAPHY, GENETICS, NESTING TRENDS, IN-WATER TRENDS)

*ESTIMATING OFFSHORE SEA TURTLE DENSITY AT SMALL SCALE: A COMBINED APPROACH WITH UAV AND MULTI-SENSORS DATALOGGERS

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Estimating offshore density in foraging areas is fundamental to set up successful conservation strategies for sea turtles as these sites are developmental areas for juveniles and frequented by adults coming from different rookeries. Studying these areas is usually challenging due to their distance to the coast and the inherent features of marine environment. The use of aerial surveys by unmanned aerial vehicles (UAV or drones) on sea turtle research increased in the last years, but with a prevalence of nearshore surveyed areas and almost without any focus on offshore sites so far. Moreover, estimating density trough aerial surveys is tricky/complex for marine/cryptic species as sea turtles that just partially spend time at surface and a correction factor (proportion of time spent on surface) is needed. Surfacing time acquired from satellite tracking data can be limited/approximative but bio-loggers can provide more precise information about turtle diving behaviour and their integration in these estimates can be a powerful tool. This study aims to provide a density estimate of loggerhead turtles within the Tunisian shelf, one of their most important foraging grounds in the Central Mediterranean Sea, and to investigate its possible variability among different areas, setting up a method that can be exported to other sites. Aerial surveys with UAVs were performed in two 1 km^2 offshore areas and the recorded videos were analyzed counting individuals. A correction index for availability bias was obtained using a recoverable animal-borne prototypical device with camera and multi-sensors integrated. Turtles equipped with this device were released and their proportion of time spent at sea surface, validating by camera recordings, was used as correction factor for density estimates. This integration of two innovative technologies represents a novel approach to estimate sea turtle density at sea, applicable to different areas and able to significantly contribute to the conservation of these endangered species.

*FIRST REGIONAL CENSUS OF THE OLIVE RIDELY NESTING IN ATLANTIC AFRICA REVEALS WEST-CENTRAL AFRICA IS HOSTING THE LARGEST OLIVE RIDLEY TURTLE BREEDING COLONY IN THE ATLANTIC

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Two civil society networks mobilized to gather field data about Olive Ridleys nesting activities along Atlantic Coast of Africa. Members of RASTOMA, the network of sea turtles in Central Africa provided

data about nesting activities from 6 countries of Central Africa: Democratic Republic of the Congo, Repubilc of the Congo, Gabon, Sao Tomé and Principe, Equatorial Guinea and Cameroun. Members of WASTCON, the West Africa Sea Turtle Conservation Network, provided nesting activity data from 6 countries of West Africa: Nigeria, Togo, Benin, Ghana, Ivory Coast and Liberia. Mobilization of the two brother networks allows for carrying out the first census covering 12 countries along the Atlantic coasts of Africa. Data mapping and analysis made it possible to update the biogeography of olive ridley nesting in Atlantic Africa. Phenology of olive Ridley nesting, as well as trends and evolution of the nesting effort geographical distribution along the Atlantic coast of Africa was modeled thanks to Pr. Marc Girondot « Phenology » R Package. Results reveal West-Central Africa hosts the largest olive ridley turtle breeding colony in the Atlantic and is among the world's most important rookeries for Olive Ridley solitary nester population.

GENETICS, MORPHOMETRICS AND HEALTH CHARACTERIZATION OF GREEN TURTLE FORAGING GROUNDS IN MAINLAND AND INSULAR CHILE

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Chilean waters constitute a foraging habitat for the endangered green sea turtle. Information about this species in the country has increased in recent years; nevertheless, little is known of its ecology and health status. Additionally, some populations have drastically decreased, probably due to human factors. Here, we studied the proportion of sex, age, morphological variation, genetic characteristics, origin, and health status of green turtles in mainland and insular Chile. We found that turtles from both regions are morphologically and genetically different. Individuals from the mainland territory are juveniles and probably originated from Galapagos. In contrast, the insular territory hosts juveniles and adults that probably originated from Galapagos and French Polynesia. We also found that turtles from both regions are facing numerous anthropic threats that must be controlled. We suggest the creation of protected areas for mainland foraging grounds, and strengthen the administrative plan of the insular region to ensure sea turtle population health.

*GREEN, YELLOW OR BLACK? GENETIC DIFFERENTIATION AND ADAPTATION SIGNATURES IN A HIGHLY MIGRATORY MARINE TURTLE

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Marine species may exhibit genetic structure accompanied by phenotypic differentiation related to adaptation despite their high mobility. Two shape-based morphotypes have been identified for the green turtle (*Chelonia mydas*) in the Pacific Ocean: the south-central/western or yellow turtle and north-central/eastern or black turtle. The genetic differentiation between these morphotypes and the adaptation of the black turtle to environmentally contrasting conditions of the eastern Pacific region has remained a mystery for decades. Here we addressed both questions using a reduced-representation genome approach (Dartseq; 9473 neutral SNPs) and identifying candidate outlier loci (67 outlier SNPs) of biological relevance between shape-based morphotypes from eight Pacific foraging grounds (n = 158). Our results support genetic divergence between morphotypes, probably arising from strong natal homing behaviour. Genes and enriched biological functions linked to thermoregulation, hypoxia, melanism, morphogenesis, osmoregulation, diet and reproduction were found to be outliers for differentiation, providing evidence for adaptation of *C. mydas* to the eastern Pacific region and suggesting independent evolutionary trajectories of the shape-based morphotypes. Our findings support the evolutionary distinctness of the enigmatic black turtle and contribute to the adaptive research and conservation genomics of a long-lived and highly mobile vertebrate.

*EVIDENCE OF POLYANDRY AND POLYGYNY IN LOGGERHEAD SEA TURTLE FROM SOUTHWEST ATLANTIC

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The migratory behavior of sea turtles and the fact that they spend most of their lives in the marine environment make it difficult to know some reproductive aspects and these gaps hinder conservation strategies. Many studies have been done to characterize the reproduction of sea turtles, including multiple paternity tests with biparental molecular markers. The present study aimed to test for the presence of polyandry, polygyny and to determine the sex ratio of the reproductive population of loggerhead turtles (*Caretta caretta*) from Povoação Beach, Espírito Santo, Brazil. For this, we analyzed nests from three consecutive nesting seasons, being 2017/18, 2018/19 and 2019/20. Four highly polymorphic microsatellite nuclear markers (nDNA) were amplified for samples from 43 nests, corresponding to 42 females and 510 hatchlings. Using the Colony program, we obtained results ranging from 1 to 7 males per nest, indicating multiple paternity in 67,4% of the nests analyzed. We also found the first evidence of polygyny (10,2%) reported to date for the *C. caretta* species. Our results showed that some males contributed to more than one nest in the same season and over the breeding seasons, which may suggest phylopatric behavior for males. Despite polyandry being a common feature among sea turtles, no evidence of polygyny was found for the *C. caretta* species until the present study. However, Gaos et al. (2018) observed a high rate of polygyny for *Eretmochelys imbricata* (31.8%), which may indicate a common behavior of mating strategy for marine turtles. The reproductive population sex ratio found was approximately 1,81 males to each female. This research presents a baseline for other multiple paternity studies of *C. caretta* in Brazil. Using the database of this work it will be possible to make future comparisons with populations from other localities, such as Rio de Janeiro, Bahia and Sergipe states, and obtain information on the male's gene flow over the breeding seasons and among localities. In this way, it will be possible to estimate the reproductive sex ratio of the species in the Brazilian coast and assist in decision making on management activities appropriate to the behavior of the species, aiming at its conservation in Brazil and worldwide.

*GENOMICS AND CONSERVATION OF THE MEDITERRANEAN LOGGERHEAD (*CARETTA CARETTA*) NESTING POPULATIONS: STRUCTURING, ADAPTATION AND PRIORITISATION

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Sea turtles are predicted to be heavily impacted by global warming, resulting in feminisation of populations and decline of hatchling survival rates. For this reason, conservation measures in the eastern Mediterranean Sea are crucial to support and monitor nesting populations. Defining the population structure and understanding mechanisms of adaptation for these species is essential to adapt current strategies and to establish conservation priorities. This is especially important in the Mediterranean, where the impact of global warming is predicted to exceed global trends. To refine the population structuring of Mediterranean loggerhead sea turtle (*Caretta caretta*) and to assess the role of local adaptation we genotyped by 2b-RAD a total of 243 individuals from 11 nesting populations. We combined this genomic information (10,725 SNPs) with environmental (salinity and temperature), behavioural (hatchling dispersal patterns and adult foraging strategies) and reproductive (clutch sizes) published data from the populations. Genomic data provided effective population sizes (Ne) that strongly correlated to the number of estimated adult breeders, and also highlighted the critical status of some of the studied populations. We found substantial genetic differentiation among most rookeries with a major break between Greek sites (including Crete) and the remaining populations. A hierarchical analysis showed the discriminant potential at population level of the set of SNPs. Consequently, the overall genetic differentiation showed reduced connectivity, confirming male and female philopatry. Outlier analysis showed string signs of local adaptation among the populations, and provided highly differentiating set of loci to further refine population assignments. Redundancy Analyses revealed significant genomic signatures associated with environmental, behavioural and reproductive population parameters, thus highlighting their importance in population differentiation in the Mediterranean Sea. Finally, we performed a conservation prioritisation analysis to identify the areas with higher priority for protection based on their global contribution in genomic variability and connectivity and found that protecting almost all rookeries is essential to retain the genetic diversity and adaptive potential. These findings can also serve as baseline for future studies on sea turtle genomics for conservation.

*DIFFERENTIAL GENE EXPRESSION BETWEEN AND WITHIN SPECIES OF SEA TURTLE EXPOSED TO A BIOLOGICALLY REALISTIC THERMAL STRESS

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Alongside widespread temperature rises, anthropogenic climate change is expected to result in increases in the frequency, severity, and duration of extreme heat events (EHEs). Sea turtle embryos are particularly vulnerable to EHEs, as they are physically restricted to eggs within terrestrial nests on marine beaches, and unable to behaviourally buffer themselves against high temperatures. Here, we expose embryos of green (*Chelonia mydas*), loggerhead (*Caretta caretta*) and flatback (*Natator depressus*) turtles to a biologically realistic thermal stress during late-stage embryonic development. We use a genome-guided transcriptome-based approach to examine differences in gene expression across and within species. Our results show that gene expression regulation differs between these three species, with variation in the overall number of genes regulated, and the associated biological pathways. We additionally demonstrate that in flatback turtles, gene expression is variable between populations, with higher overall regulation at locations that experience overall lower incubation temperatures *in situ*. These results suggest that acute thermal stress response is variable both between and within-species, with local adaptation and preconditioning likely influencing individual response.

CURRENT METHODS FOR DETERMINING HATCHLING SEX AND POTENTIAL FUTURE DIRECTIONS

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Imperiled species with temperature-dependent sex determination (TSD), such as sea turtles, are especially vulnerable to climate change. A small increase in nest temperature can result in female-biased primary sex ratios and low male production. If female-biased primary sex ratios are extreme and prolonged, eventually breeding sex ratios will suffer and lead to population collapse. Primary sex ratios are an important demographic parameter that are poorly measured due to methodological limitations. However, they are the foundation upon which future generations' sex ratios are built. Currently, there is no simple or non-invasive approach to identify the sex of a sea turtle hatchling. Sea turtle hatchlings lack both sex chromosomes and external sexually dimorphic characteristics to distinguish between male and female hatchlings. Direct methods for sex identification such as histology and laparoscopy are not feasible for large scale sex ratio measures. For hatchlings, histology of gonads requires sacrifice of the turtles which is counterproductive when working with imperiled species. Laparoscopic sex identification is not lethal, but hatchlings must be reared for weeks to months which is requires sufficient facilities, specialized training, and can be costly. Another approach is to use incubation temperature as a proxy for sex ratios. Often, the average temperature of middle third of incubation is used to estimate sex ratio of *in situ* nests, yet mean temperatures seldom predict sex ratios. Recent studies show that the thermosensitive period (TSP) doesn't always match the middle third of incubation, resulting in erroneous sex ratio predictions. To aid bias reduction, models have

been developed that account for the effect of temperature on embryo growth rate and sexualization. Such models allow for a more accurate identification of when the TSP occurs in *in situ* nests and therefore a better estimation of nest sex ratios. However, to date, there is no way to robustly validate such proxies via non-invasive or minimally invasive methods. Recent work has identified a sex-specific protein, anti-Müllerian hormone (AMH), in male loggerhead sea turtle hatchling blood and its value for hatchling sex identification. In this work, a human antibody was used for the detection of AMH in loggerhead (*Caretta caretta*) hatchlings via Western blots. Even though effective to identify males versus females, the low specificity of this antibody prevents the development of more sensitive or rapid approaches. Additionally, we tested this commercial antibody on green turtle (*Chelonia mydas*) plasma and surprisingly, it detects a protein around the same molecular weight of AMH in both male and female plasma, suggesting that AMH might not be sex-specific in this species. We are currently working to verify the identity of this protein. This study highlights the need for (i) sex identification methods to be validated on a species-by-species basis, and (ii) a fast, direct, non-lethal method to measure hatchling sex ratios at the population level of all sea turtle species.

*LONG-TERM TREND OF OLIVE RIDLEY TURTLES NESTING IN BRAZIL REVEALS ONE OF THE LARGEST ROOKERIES IN THE ATLANTIC

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Northeastern Brazil supports an important population of olive ridley turtle (*Lepidochelys olivacea*) that was historically depleted due to several human activities. Here, we present a long-term trend in numbers of olive ridley nests observed throughout 16 years of beach surveys. From 2003/2004 to 2018/2019 nesting seasons, we recorded nest counts along coastline of Bahia (214 km) and Sergipe (116 km) states between September and March. Given that remigration intervals in the literature for olive ridley is 1.5 years, we evaluated the nesting trend using a generalized least square model with log transformed nest counts and autocorrelation errors to account for any temporal correlation. We also estimated the minimum number of females nesting annually based on clutch frequency (CF). CF was determined from approximately 5,000 individual nesting females over 16 years in Sergipe which indicated that 88.4% of female nest once in a season, 11% nest twice, and 0.6% nest three times in a season. Our results indicate an upward trend in annual nest counts between 2003/2004-2018/2019 with a significant increase every two years. We also observed a 50-fold increase in nesting numbers when comparing the 12,709 nests estimated in 2018/2019 season to the 252 nests counted in 1991/1992. Based on the average number of nests laid in the last three nesting seasons we estimated that about 11,923 females nested annually over the study area. Our results highlight that Brazil currently supports the second largest population of olive ridley in the Atlantic. The significant increase achieved between the nesting seasons is probably the direct result of conservation actions carried out in the Atlantic both at the foraging and nesting grounds. In Brazil, uninterrupted conservation actions were promoted over four decades by Projeto Tamar, based on an adaptive threat management framework and community-based development strategy to achieve sea turtle conservation goals. For example, poachers were hired to work as "tartarugueiros" to patrol the beaches and protect sea turtles; employment opportunities were generated through product/merchandise manufacturing and handicrafts; and uninterrupted conservation actions implemented on nesting beaches since the 80's contributed to high hatchling production. Despite this increasing trend, a high level of mortality of mature olive ridleys due to incidental catch in trawl fishery has been reported and is a matter of concern for the conservation and population stability in Brazil.

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*TWENTY YEARS OF MONITORING AND TRACKING GREEN TURTLES IN WEST AFRICA: WHAT HAVE WE LEARNT?

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During the 1990s, a major nesting beach for green turtles *Chelonia mydas* was found on the island of Poilão, Bijagós Archipelago, Guinea-Bissau. In the year 2000 a first comprehensive survey was carried out, yielding a total of 7400 clutches laid in that season. Since that period, regular monitoring by Guinea-Bissau authorities (IBAP) at Poilão documented a marked population growth, with a maximum of 71,000 nests estimated in 2020. This site is currently the third most important in the whole Atlantic Ocean. No other nesting sites of this order of magnitude are known or likely to exist along the Atlantic coast of Africa. In 2001 female green turtles nesting on Poilão were satellite-tracked, the first such tracking in the whole of West Africa. Between 2018 and 2021 further tracking took place on an annual basis. Tracking allowed the identification of major foraging sites, which were later visited to confirm the presence of large number of turtles. Overall, half of the adult females (N=46) migrated to the Banc d'Arguin, in Mauritania; 22% migrated to the Delta du Saloum area (Senegal) and 26% remained foraging in the Bijagós Archipelago (Guinea-Bissau). One turtle migrated to Ghana. Migratory destinations showed significant inter-annual variations. The turtles made heavy use of the network of marine protected areas (MPAs) of West Africa (the RAMPAO). During the interesting period, 95% of the tracking positions of adult females fell inside designated MPAs. Of 46 successfully tracked to the foraging areas, 80% used shallow waters within the limits of MPAs and most of them remained within MPA limits for most of the foraging tracked time. Green turtles provide a compelling example of the existing biological connectivity between MPAs in various countries and confirm the relevance of such networks and of international collaboration for biodiversity conservation. In 2021, we captured 12 male green turtles on the mating grounds around Poilão and satellite tracked them, together with a sample of 13 nesting females. Most females migrated to Mauritania, moving more than twice the distance as males, which mostly stayed in Senegalese waters. This is the first ever robust comparison of migratory behaviour of male and female green turtles, revealing a statistically significant sex-based difference in migratory distance. Overall, the long-term studies, which run parallel to significant conservation efforts at sea and on the nesting beaches, highlighted an apparently healthy green turtle population, well protected by the current MPA network. Nevertheless, conservation challenges remain, particularly considering the ever-increasing fishing effort and fisheries-related mortality in the region and the still important local illegal harvesting at some nesting beaches. Further, the West African green turtle population seems to be highly reliant on the extensive sea grass beds of the Delta du Saloum and of the Banc d'Arguin, and these are forecast to suffer heavy losses as a result of climate change.

*THE IMPORTANCE OF LONG-TERM MONITORING AND TAGGING FOR THE SPECIES HAWKSBILL TURTLES (*ERETMOCHELYS IMBRICATA*) AT FEEDING, FORAGING SITES AND NESTING BEACHES IN JIQUILISCO BAY, EL SALVADOR

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At the beginning of the 2000s it was believed that hawksbill turtles (*Eretmochelys imbricata*) were nearly extinct from the eastern Pacific. In 2008, thanks to research conducted by scientists and local community led on the Salvadoran coast, a light of hope was discovered for this critically endangered species. Since then, research efforts and conservation go hand in hand with coastal communities. Sea turtles are tagged in most cases to obtain information on reproductive biology, movements, strandings, distribution, and growth rates. In El Salvador, the first tagging of a hawksbill turtle was conducted in 2008 in Jiquilisco Bay, in which Inconel tags, PIT (Passive Integrated Transmitter) and satellite telemetry were used. A nesting female, named Isabela, was the first sea turtle tagged in El Salvador and she has been transmitting information since 2008 until the current year 2022, valuable data has been recorded such as movements and growth rates. This is a clear example of the importance of long-term marking and monitoring in feeding sites, foraging areas, and nesting beaches. Four years later, in 2012, another nesting female was tag with a satellite transmitter, her name was Manglita. who was found dead due to a blast fishing incident one month later. This unfortunate event led to take measures to continue the conservation of this species and make the communities aware of blast fishing consequences. Tagging methods that may be successful in one location and under certain circumstances, may be inappropriate elsewhere. For El Salvador, the most efficient technique is to place tags on the second scale of each one of the front flippers, and to insert the PIT subcutaneously on the right flipper. From 2008 to date, around 550 nesting hawksbill females have been tagged throughout Salvadorean coasts, allowing the collection of data such as: the returning of individuals to nesting beaches, tag's lost and retagging, growth rates, strandings and deaths. This Tagging program in feeding and foraging areas, started on 2015 in three different sites at Jiquilisco Bay. Since then, around 400 individuals have been marked in different life stages. In conclusion, it is possible to obtain very valuable information through these tagging programs, including growth rates, sighting frequencies, nesting beach fidelity, and mortality rates. This conservation program also implements strategies and creates awareness in coastal communities regarding the conservation of these critically endangered species.

HONU COUNT: USING SHELL-ETCHINGS AND COMMUNITY SCIENCE TO TRACK AND MONITOR THE CENTRAL NORTH PACIFIC GREEN SEA TURTLE POPULATION

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The abundance of the Central North Pacific Distinct Population Segment of Hawaiian green sea turtles (honu) has largely been determined by counting the number of females nesting within Lalo (French Frigate Shoals Atoll). This atoll is located approximately 1,000 km northwest of the main Hawaiian Islands (MHI)

within the Papahānaumokuākea Marine National Monument. Honu make round trip migrations from foraging grounds in the MHI to nesting grounds in Lalo, where The National Oceanic and Atmospheric Administration (NOAA) has administered an ongoing honu monitoring program since 1973. To better identify from afar, NOAA scientists use "motos," an alpha-numeric identifier temporarily etched onto the carapace with a mototool and painted with non-toxic white paint. Since motos can last for 6-12 months, the public can identify honu within the MHI, which inspired the creation of a Citizen Science project. In 2017, NOAA's Pacific Island Fisheries Science Center's Marine Turtle Biology and Assessment Program launched The Honu Count Project, which facilitates public reporting on sightings of honu with motos around the MHI. The initial focus of Honu Count was to generate information on migration routes from Lalo to the MHI, as well as identify key foraging grounds at the latter. Honu of all size-classes around the MHI are also given a moto, which assists with tracking post-rehabilitation status, monitoring movements and foraging habitat for the overall population. From 2017-2021, approximately 2,643 motos have been applied to honu; 1,942 (73%) motos were applied at Lalo and the remaining 701 (27%) were applied within the MHI. A total of 612 reports were received from over 200 members of the public of 193 individual honu. The majority (n = 171) of the observed motos had been applied within the MHI and were re-observed within the region. However, 22 sightings were of honu originally tagged at Lalo and re-sighted within the MHI. Of these 22 sightings, 10 were reported on Maui, 7 on Oahu and 3 on Kauai. The final 2 sightings were reported with not enough information to determine the location. Honu Count has evolved from hotline, to email, and now enters a new phase that will increase reporting and streamline data collection from the public. This past year, we developed an online survey format using the Esri product ArcGIS Survey123. This easy-to-use survey provides the public with a direct link where they can report sightings and input the latitude and longitude of a sighting on a map, improving the accuracy of the location. This can then be analyzed using various tools in ArcGIS or exported for use in other software (e.g., R Programming). The survey link is embedded into a newly developed website created to promote the project, give instructions on how to report sightings, and provide additional information. This evolution of Honu Count with a new survey format and website will continue to increase Honu Count's ability to generate invaluable data on population conservation, foraging habitat, and migration routes, all while improving NOAA's engagement with the public.

*ATLANTIC-WIDE CONNECTIVITY IN ASCENSION ISLAND GREEN TURTLES, REVEALED BY MITOCHONDRIAL DNA

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Marine turtles exercise long migrations across different geographies and habitats, exposing them to a wide range of threats throughout their lifespan. Unravelling marine turtle connectivity is key to informing effective conservation management. Genetic analysis has been a key contributor in elucidating connectivity in marine turtles, but many data gaps remain, including a lack of mtSTR haplotypes from South Atlantic green turtles (*Chelonia mydas*). In this study, we characterise the genetic structure of the Ascension Island nesting population, one of the biggest rookeries in the Atlantic Ocean. Having suffered significant depletion historically due to mass harvesting for consumption, the population is in recovery due to conservation efforts. Our study expands on previous genetic characterisation of the rookery, analysing higher resolution genetic markers and employing mixed stock analysis (MSA) to provide novel insight into the contribution of Ascension Island to Atlantic juvenile foraging aggregations. Novel data from several other South Atlantic rookeries and foraging grounds are also included in the analyses. From green turtle biopsy samples (n = 303) collected from nesting females in 2015 and 2016, we amplified a ~738 bp D-loop segment and a higher resolution ~200 bp short tandem repeat (mtSTR) segment of the mitochondrial DNA (mtDNA) control region. These genetic markers were used to assess the genetic structure of Atlantic nesting populations and carry out Bayesian one-to-many MSA, weighted by nesting population size, to assess the extent to which South Atlantic foraging aggregations were made up of the Ascension Island originating turtles. Overall, 11 extended D-loop and 19 mtSTR haplotypes were found. The dominant D-loop haplotype was CM-A8, with 2 extended variants present (CM-A8.1 and CM-A8.3). Population structure analysis of Atlantic nesting populations found three main genetic groups using extended D-loop markers: Northwest Atlantic, South Caribbean, and the South Atlantic and West Africa. mtSTR analysis suggested that Guinea Bissau in West Africa was more genetically separate when compared to the rest of the South Atlantic regional management unit. Mixed stock analyses suggested that Ascension Island is a major source for Southwest Atlantic foraging aggregations (D-loop: 40.4-54.3 %, mtSTR: 69.9-87.4 %) and is also important to West African foraging aggregations (D-loop: 2.8-3.4 %, mtSTR: 5.5-10.4 %). Our results show that Ascension Island is a key contributor to foraging grounds in Brazil, with important links to West Africa. Green turtles are vulnerable to fishery bycatch in these areas, and so these findings are important for informing the international collaboration necessary for conserving the Ascension Island population. Our study highlights the relevance of using mtSTR haplotypes in marine turtle connectivity analyses and suggests that improving marker resolution and sample sizes can further elucidate *green turtle* connectivity to optimise conservation strategies.

APPLYING UNMANNED AERIAL SYSTEM TO QUANTIFY FORAGING MARINE TURTLE POPULATION OF SEMPORNA PRIORITY CONSERVATION AREA, MALAYSIA

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The northeast islands of Semporna Priority Conservation Area (Semporna PCA) of Malaysia comprises of six islands that host significant nesting population for the state of Sabah, Malaysia. Although beach monitoring was extensively done in the area, there is growing need to understand the status and function of the foraging grounds in the area. This study reports a result of a preliminary survey that quantified and mapped the foraging marine turtle population at the nearshore of northeast islands of Semporna PCA through the use of unmanned aerial vehicles (UAVs). The drone-based surveys were carried out for six days in June 2021, covering a total area of approximately 115 hectares (1.15 square kilometers). The survey resulted a total of 1,250 individuals of marine turtles encountered. These included i) Pom Pom Island (361 individuals), ii) Mataking Island (305 individuals), Boheyan Island (255 individuals), Pandanan Island (163 individuals), Timba-Timba Island (140 individuals) and Kulapuan Island (26 individuals). This survey provides valuable information on the marine turtle population of Sabah, which further establishes the value of the northeast islands of Semporna PCA as an important area for both nesting and foraging which required

to be managed and protected holistically. This is a first study of its kind in Semporna PCA and demonstrates the usage of applying UAVs as a survey tool to assess marine turtle population.

LOCAL ECOLOGICAL KNOWLEDGE SUPPORTS IDENTIFICATION OF SEA TURTLE NESTING BEACHES IN PANAMA

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We report on a study of previously un-surveyed sea turtle nesting beaches in an isolated region of the Azuero Peninsula in central Pacific Panama. The initial identification was based on information collected during semi-structured interviews (n = 21) in 12 communities. These engagements gauged local ecological knowledge (LEK) with emphasis on the critically endangered Leatherback Turtle (*Dermochelys coriacea*). Interview responses identified 22 beaches with sea turtle nesting activity. From these, we surveyed nine beaches: Cacajilloso, El Gato, Sandillal, Colorado 2, Sierra, Granada, Frijoles, Verde, and Horcones beaches. Nesting activity was documented by observing crawl tracks on the beach and/or directly encountering female turtles. In total, we observed 128 crawl tracks representing two species: Green Turtles (*Chelonia mydas*, n = 92) and Olive Ridley Turtles (*Lepidochelys olivacea*, n = 36). We also directly encountered Green Turtles (n = 16), Olive Ridley Turtles (n = 25), and Hawksbill Turtles (*Eretmochelys imbricata*, n = 2) during surveys. Olive Ridley Turtles had the most widespread nesting activity (six of nine beaches), followed by Green Turtles (four of nine beaches) and Hawksbills Turtles (two of nine beaches). We saw no evidence of Leatherback Turtle nesting, despite LEK suggesting the species had previously nested at several of the surveyed beaches; this lack of evidence is consistent with its critically low (and still declining) population size in the eastern Pacific. In addition to highlighting the value of LEK, our study provides novel information on the distribution and abundance of sea turtles in remote areas in Panama.

*NATAL HOMING OF MALE GREEN TURTLES (*CHELONIA MYDAS*) IN AVES ISLAND, VENEZUELA AND ATOL DAS ROCAS, BRAZIL

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Studying the origins of male green turtles is critical to assess their unknown degree of philopatry with respect to that of females, which is characterized by a high level of natal homing. We collected tissue samples of male and female sea turtles in two nesting, courtship and mating areas: during 2008-2010 and 2012 in Aves Island, Venezuela (AVm=87 males and AVf=225 females), and during 2004-2006 in Atol das Rocas, Brazil (RAm=30 males and RAf=37 females). By sampling males and females in the same reproductive area, for the first time we assessed the degree of male sea turtle philopatry by sequencing a fragment of the mtDNA control region (~857bp). Intrapopulation comparisons between males and females revealed no genetic differentiation between sexes in either locality (AVm and Avf, F_{ST}=0.004 p=0.221 and RAm and RAf, F_{ST}=-0.012 p=0.711). We also combined these results with published data from 2,350 individuals from 32 other green turtle rookeries in the Gulf of Mexico, Caribbean, Atlantic and the Mediterranean. A Mixed Stock Analysis of 4 regional groups revealed that adult males sampled at Aves Island originated in nesting colonies in the eastern Caribbean, mainly from Aves Island (94.7 %) with minor contributions from Suriname (1.12%) and Buck Island (0.4 %). Alternatively, adult Atol das Rocas males originated not only from Western Caribbean colonies but also from other rookeries in the Atlantic, including Fernando de Noronha (49.18%), Trinidad (25.56%), Poilao in Guinea Bissau (5.94%), Ascension Island (4.83%), Suriname (4.30 %), Aves Island (3.48%) and Sao Tome (1.12%). These combined results indicate that males from Aves Island and Atol das Rocas home to their natal regions like females do, although the degree of philopatry may be stronger for Aves Island turtles than those from Atol das Rocas. This study thus provides the first direct evidence supporting differing degrees of male natal homing to courtship and mating areas in the Caribbean and the western Atlantic. Elucidating the factors causing these differences in courtship areas is important for understanding the degree of demographic independence among populations, and hence their vulnerability to regional threats. This study emphasizes the importance of actively investigating male sea turtles to assess their reproductive behavior, the global status of sea turtle populations and to establish new conservation strategies for the future.

A SYNTHETIC INDICATOR BASED ON NESTING TREND TO INFORM THE GENERAL PUBILC ABOUT THE STATUS OF SEA TURTLE IN FRANCE AND ITS TERRITORIES

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The French National Biodiversity Observatory (ONB) has developed a synthetic indicator for marine turtles to describe the situation of marine turtle populations in France and its territories. The exercise consists in informing the general public, using a unique synthetic value, on the state of marine turtles in France, knowing that 4 species of marine turtles lay eggs in France: the green turtle, the loggerhead turtle, the hawksbill turtle and the leatherback turtle, in the French territories distributed in 3 oceans: Atlantic, Pacific and Indian Oceans. The apporach chosen is an indicator of marine turtle population trends based on the trend of nesting activities. The value of the indicator corresponds to the proportion of the monitored nesting sites most frequented by marine turtles in France where nesting activities have decreased over the last 7 years. The number of reproductive female turtles is difficult to observe and measure directly, but its trend can be inferred from a correlated variable (a proxy). The number of nests or tracks left by females is counted during morning patrols of the nesting beaches. The trend in the number of tracks or nests is used as a proxy for sea turtle population trends. We reason in terms of sites-species. Indeed, the link between the trend of nesting activities and the size of the female breeding population exists but it is specific to a given species and site. The indicator is calculated using data produced by the actors of the French Marine Turtle Group (GTMF) who implement the protocol for nesting beach monitoring and counting nesting activities established by Prof. Marc Girondot, in accordance with the international recommendations published in the SWOT Minimum Standard. As a result, in 17% of the sites most frequented by marine turtles in France and its territories, nesting activities have decreased over the last 7 years. The observation of a negative trend on a proportion of the sea turtle nesting sites in the French territories is a sign of a decrease in the abundance of reproductive females or of a shift of the nesting effort towards other beaches, which can be a sign of a decrease in the viability of a nesting habitat. As sea turtles occupy varied and rather high positions within trophic chains, they are good indicators of the functionality of the environment. The evolution of sea turtle abundance is therefore a good indicator of the health of marine ecosystems. The percentage of sites where the trend of marine turtle populations is not unfavorable is high. The current situation is therefore globally satisfactory. However, it is heterogeneous and the situation is particularly worrying for the leatherback turtle in Guyana where the trend of the nesting population is very unfavorable.

HAVE YOU EVER SEEN A LOGGERHEAD DANCE? RECORD OF A POSSIBLE *LEPIDOCHELYS KEMPII* X *CARETTA CARETTA* HYBRID IN TAMAULIPAS, MEXICO

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Hybridization among five of the seven sea turtle species is currently documented, but the consequences this can imply in the conservation and evolutionary diversification of these species are still unclear. Interbreeding involving the species *Lepidochelys kempii* is one of the least documented and studied cases. In the 2022 sea turtle nesting season in Rancho Nuevo, Tamaulipas, the main nesting site for the Kemp's ridley turtle in the Gulf of Mexico, we encountered a possible *L. kempii* and *Caretta caretta* hybrid on two separate occasions. We encountered this individual during regular patrols, initially, we identified it as a *C. caretta* based on its morphological characteristics, but while it was covering the egg chamber, it presented the rocking behavior characteristic of the genus *Lepidochelys*. Further analysis of the morphological and behavioral characteristics of this individual and its offspring gives reasonable reasons to lead us to believe it is a hybrid turtle. Although this phenomenon is considered common by the locals, it has only been reported in the literature once before, therefore we considered it important to share the information with the scientific community. Until now, the genetic analysis to confirm the hybrid status has not been performed yet, but we expect to count on it soon. Further analysis is necessary, to be aware of the genetic and conservation implications this might represent for the survival of these endangered species.

CARMOCUMA: A PILOT STUDY TO ESTABLISH AN INDEX SITE FOR MONITORING OF LOGGERHEAD TURTLE ABUNDANCE IN THE HIGHLY IMPACTED COASTAL HABITAT OF CUMA, SOUTH-WEST ITALY

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The conservation of sea turtles requires a detailed understanding of their population size, spatial distribution and demographic trends. Population trend estimates of the Mediterranean loggerhead turtle sub-population was based on nest counts of a few long-term monitored nesting beaches, while to date no systematic monitoring in foraging grounds has been carried out. This project began in 2019 with the aim to establish an index site to monitor loggerhead turtle abundance in a coastal foraging habitat in a densely urbanised area north of Naples, SW Italy, where sea turtles are known to occur year-round but mostly due to the frequent stranding of dead turtles. Fieldwork concentrated on boat monitoring surveys of a shallow water area of approximately 130 km^2 using initially an equal distance zigzag transect design, which was later substituted by strip transects along the 8-m and 12-m isobars. In total, 15 days at sea were made, seven of which dedicated to transect line monitoring and 8 days dedicated to strip monitoring. A total of 37 turtles were observed, and two turtles were caught using the rodeo technique, one of these was rescued from discard of a bottom trawler. The 95% Kernel Density Estimate home range was distributed along a 17 km coastal strip between 5 and 15 m of depth with a mean perpendicular distance to the coast of 1.25 km. In addition to the boat surveys, in May 2022 we monitored strip transects in a tooth pattern each 6 km long using unmanned aerial system (UAS, DJI Phantom 4 pro). On four days we flew 9 transects and observed 11 turtles, all within less than 1 km perpendicular distance to the coast. Turtles were large individuals and on one occasion, the courtship of a male and female turtle could be recorded. This came as no surprise since we discovered new nesting sites in the study area during the course of this project. We have not yet recorded enough turtle sightings to estimate abundance, but experience gathered so far already helped to refine the survey protocol, and the monitoring will be continued to produce a first estimate for number of turtles using these waters. This way we will be able to assess the impact of fisheries bycatch causing the dead strandings every year.

GENETIC DIVERSITY OF GREEN TURTLES AT DEKAMER, RESCUE CENTER, TÜRKIYE: A CASE STUDY OF SHORT TANDEM REPEATS(STR) OF MTDNA

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The first sea turtle rescue centre (DEKAMER) in Turkiye was established in 2008 and have been receiving injured turtles. A total of 483 (n=344 loggerheads-*Caretta caretta* corresponding to 69% and n=139 green turtles-*Chelonia mydas* corresponding to 28%) turtles were admitted to the centre. A total of 297 (54%) were treated, recovered and released back to the sea as healthy individuals. The main causes of injuries and deaths were found to be related to fishery and boat activities, such as fishing line, hook ingestion, fishing line entanglement (36%), 28% can be classified as physiological natural causes, with a 10% cause of intentional injuries. There was also an important impact (16%) of propeller cuts and speed boat damages. Together with these rehabilitation facilities we also analyzed the genetic origin of the green turtles with the elaboration of the mtDNA control region is not very useful for understanding population structure in Mediterranean green turtles due to presence of a single haplotype. Therefore, we used the 'AT' repeat region in the 3′ end of the control region of the mitochondrial DNA holds more promise, as it contains four different Short Tandem Repeats (STR) separated by short spacers. We analyzed 139 green turtle samples. We compared with the literature of nesting and stranded individuals and found more new haplotypes detected at the turtles admitted to the rescue center. There are nests recorded at the western locations were at what is considered the end of the nesting season and activities may have been under taken on the way to migration to foraging areas. The green turtle population may shove more genetic diversity that known from nesting beaches. In addition to the STR numbers most commonly found were 6-8-5-4 (29,6%), 6-8-8-4 (24%), 6-8-7-4 (10%) and 6-8-6-4 (10%). A total of 12 new haplotypes were detected from turtles admitted to the center. These were 4-6-8-5-4 (n=1), 4-7-8-6 (n=1), 6-8-4-4 (n=1), 5-8-4-4 (n=1), 6-12-5-4 (n=1), 4-5-8-7 (n=1), 4-5-8-6(n=1), 4-6-7-7 (n=1), 4-7-7-7 (n=1), 4-7-7-8 (n=1), 5-7-8-6 (n=1) and 6-9-5-4 (n=1). The Mediterranean green turtle population is relatively small compare with the loggerhead turtle population as this also seen from the percentage of turtles admitted to the center. This genetic diversity shows how important the rehabilitation of turtles as well as additional protection of their genetic diversity.

*HAWKSBILL NESTING TRENDS INCREASED SIGNIFICANTLY AT SANDY POINT NATIONAL WILDLIFE REFUGE, ST. CROIX OVER 30 YEARS

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Sandy Point National Wildlife Refuge (SPNWR), located on St. Croix, U.S. Virgin Islands, has been monitored for three species of nesting sea turtles since the late 1970s. For this study, 4,781 historical records of hawksbill activities at SPNWR from 1981-2022 were compiled, digitized, and analyzed to assess nesting trends. However, consistent data collecting and reporting techniques allowed for a confident analysis of the data from 1993-2022. A linear model was used to identify trends in total hawksbill activities, nests, and nesting success during the core nesting season (June to October) from 1993-2022. From 1993-2008 an average of 44 hawksbill nests were reported at Sandy Point annually. From 2009 to 2022, the average number of hawksbill nests reported at Sandy Point increased to 241. Through this effort, significant increasing trends were identified in total activity, 7.8% per year, and in the number of nests, 4.6% per year.

This may be attributed to the successful conservation measures established throughout the region in the late 20th century and the protection provided to the refuge to protect leatherbacks. This study is the first in depth investigation into historical trends in hawksbills' use of SPNWR as nesting habitat. The increasing trends identified here indicate that SPNWR supports a regionally significant hawksbill nesting population previously underestimated. We propose that SPNWR become an index nesting beach for hawksbills in the Wider Caribbean due to increasing trends and protected status. Standardized monitoring of this beach should be continued to further characterize this population and its stability across time. In addition, the widespread nesting throughout the west end of St. Croix, including outside the refuge, should be evaluated to understand better hawksbill nesting on this important island under U.S. jurisdiction.

ORIGINS OF JUVENILE GREEN SEA TURTLES (*CHELONIA MYDAS*) IN THE BAHAMAS: A COMPARISON OF RECENT AND HISTORICAL ROOKERY CONTRIBUTIONS

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Conservation of green sea turtles (*Chelonia mydas)* benefits from knowledge of population connectivity across life stages. Green turtles are managed at the level of genetically discrete rookeries, yet individuals from different rookeries mix at foraging grounds; therefore, rookeries may be impacted by processes at foraging grounds. Bimini, Bahamas, hosts an important foraging assemblage, but rookery contributions to this assemblage have never been resolved. We generated mitochondrial DNA sequences for 96 foraging green turtles from Bimini and used Mixed Stock Analysis to determine rookery contributions to this population using 817 and 490 base pair (bp) rookery baseline data. The MSA conducted with 817 bp data indicated that Quintana Roo, Mexico, and Central Eastern Florida contributed most to the Bimini population. The MSA conducted with 490 bp data indicated that Southwest Cuba and Central Eastern Florida contributed the most to Bimini. The results of the second MSA differ from a previous study undertaken with 490 bp data, conducted in Great Inagua, Bahamas, which suggested that Tortuguero, Costa Rica, contributed the most to that foraging assemblage. Large credible intervals in our results do not permit explicit interpretation of individual rookery contributions, but our results do indicate substantial relative differences in rookery contributions to two Bahamian foraging assemblages which may be driven by oceanic currents, rookery sizes, and possibly juvenile natal homing. Our findings may implicate a shift in contributions to the Bahamas over two decades, highlighting the importance of regularly monitoring rookery contributions and resolving regional recruitment patterns to inform conservation.

NEST TRACKER APP – DIGITAL DATA COLLECTION IN THE CAYMAN ISLANDS

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The Cayman Islands Department of Environment Marine Turtle Research Programme began operating in 1998 and monitors the nests of Loggerhead, Green and Hawksbill turtles on all 3 islands; Grand Cayman (22 beaches / 65 participants), Little Cayman (18 beaches / 10 participants) and Cayman Brac (19 beaches / 35 participants). In the first year of data collection 30 nests were recorded in total; in 2022, 858 nests were

recorded. As nesting activity increased, the pen/paper system used to collect data became increasingly cumbersome. The Nest Tracker app was developed as a custom-built app for use on iPads to standardise and streamline data collection, increase accuracy, and reduce time inputting data. A key feature in the development was to create a daily emerging nest list (ENL) that provides a list of nests that are due to hatch sorted by beach location. The Nest Tracker app was introduced in Grand Cayman in 2017 and in Little Cayman and Cayman Brac in 2019. The app keeps track of each nest by recording nesting female ID, nest location, predicted emergence date, excavation data and misorientation of hatch (if applicable). The app automatically creates the ENL, avoiding time consuming manual calculations. All of the data input from each day is available within the app and is also emailed daily to the research team in the form of an Excel spreadsheet. This allows easy and immediate access to all nesting data from any location. We have found many advantages to this form of data collection – most importantly: increasing data standardisation and quality, eliminating manual data entry, and allowing real-time access to data for management interventions. Each year, the app is updated, improved, and refined to better meet the needs of the project. We present lessons learned through the development process of the app, pros and cons, and unexpected benefits. Nest Tracker is an innovative tool which is easily adaptable and has the potential to increase data collection accuracy and efficiency for turtle conservation projects worldwide.

EVALUATING STOCK ORIGIN OF JUVENILE EAST PACIFIC GREEN TURTLES OFF OF SOUTHERN CALIFORNIA, USA, USING MTDNA

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East Pacific green turtles (*Chelonia mydas*) inhabit coastal foraging areas in southern California, USA. The areas of San Diego Bay (SDB), San Gabriel River (SGR) and Seal Beach National Wildlife Refuge (SBR) comprise the northernmost mosaic of foraging areas for this species, where they are present year-round. In addition, green turtle strandings along the U.S. west coast primarily occur in southern California. There has been an increased presence of juvenile green turtles throughout the region, likely a result of the significant recovery of the Mexican breeding population following several decades of successful conservation. Improving our understanding of population structure is vital for effective conservation and management efforts, especially when turtles are faced with human threats in urbanized areas throughout southern California. Once residency has been established, green turtles are known to exhibit foraging site fidelity, and foraging populations are often of mixed stock origin (e.g. animals from multiple nesting populations). The primary goal of this study is to identify source populations for juvenile green turtles in the eastern Pacific region. From 2010 to 2022, we sampled 100 juvenile green turtles during in-water monitoring efforts in SDB, SGR, SBR, and 75 juvenile strandings recovered throughout southern California. In addition, we collected a variety of morphometric data from each turtle. Juveniles were defined by a curved carapace length less than 82.0 cm CCL. Samples were analyzed using 780 bp of the mitochondrial (mtDNA) control region sequence and compared to published data for potential source populations in the eastern Pacific. Preliminary analysis observed 18 haplotypes among the three foraging sites and strandings. Variation in the composition of haplotypes between sites were observed. Using Bayesian Mixed Stock Analysis and similar to Dutton et al. (2019), we found that animals originate primarily from the Revillagigedo Islands and Michoacán nesting sites. Of the 18 haplotypes identified, six are new “orphan” haplotypes not previously reported from any of the nesting sites sampled to date and there are several key nesting sites that have yet to be sampled (e.g., Tres Marias Islands), illustrating that knowledge gaps still exist. Our findings are relevant to the current conservation and management issues relating to east Pacific green turtles. With the rapid recovery of east Pacific green turtle populations on mainland nesting sites in

Michoacán, we expect to continue to see an increase in juvenile green turtles in the region. Our results suggest that the lesser-known Revillagigedo nesting population is a significant source for southern California foraging populations, illustrating the need for more comprehensive sampling of females at the more traditional nesting sites, as well as lesser known sites. Understanding the fine scale population structure of these new recruits will help us to respond to emerging threats as they arise.

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*LOW RATE OF MULTIPLE PATERNITY AND A BALANCED BREEDING SEX RATIO IN HAWKSBILL TURTLES

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Understanding the breeding dynamics of rare and endangered species, including breeding sex ratios and relative contributions of individuals to the next generation, is important for assessing population resiliency. Determining breeding sex ratios is of particular relevance for species with temperature-dependent sex determination, such as marine turtles, to track shifts in breeding sex ratios driven by climate change. However, complex oceanic life cycles for marine turtles hinder research on individuals and life stages beyond nesting beaches. Despite advances in oceanic monitoring, male breeders remain under-represented from demographic studies. Here, we estimated the breeding sex ratio and described mating behavior for Eastern Caribbean (EC) hawksbill turtles by reconstructing paternal genotypes with molecular genetic assays of nesting females and their hatchlings at Jumby Bay (JB), Antigua. We genotyped 681 hatchlings from the nests of 23 females with five polymorphic microsatellite markers and generated paternal identities with a maximum-likelihood, full-pedigree reconstruction program. Overall, 24 discrete male genotypes were reconstructed from the nests of 23 females at JB, indicating a nearly even sex ratio for the JB breeding population. Single paternity was found for the nests of 21 out of the 23 females. Multiple paternity was found for the remaining two nests (8.7%), with primary paternal contributions of 57 and 80%, respectively. One male also sired the clutches of two different females, providing evidence of polygyny. A nearly even breeding sex ratio, low variance in reproductive contributions among breeders, and no evidence of historical demographic perturbations all suggest minimal reduction in effective population size for the JB breeding population. Our results suggest a low density of breeding hawksbills in the EC and provide baseline data for EC hawksbills to improve demographic assessments and track breeding sex ratios over time.

GROWTH OF *ERETMOCHELYS IMBRICATA* RECAPTURED IN-WATER MONITORING IN NATURAL RESERVE ESTERO PADRE RAMOS, NICARAGUA 2016-2022

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Hawksbill turtles (*Eretmochelys imbricata*) inhabiting the Eastern Pacific Ocean are one of the seven most endangered sea turtle populations on the planet (Wallace et al. 2011) and not long ago were thought to be extinct in the region. Through research efforts led by Fauna & Flora International (FFI) and the Eastern Pacific Hawksbill Initiative (ICAPO), a substantial and critically important hawksbill nesting site was discovered in the Estero Padre Ramos Natural Reserve (EPR) in Nicaragua in 2010. FFI has been leading efforts with ICAPO and local partners to implement hawksbill conservation at the site since that time. In 2016 FFI initiated in-water monitoring of hawksbills at EPR as part of a regional effort led by ICAPO to generate information on species abundance, growth, and other demographic data. Hawksbill captures within the estuary, where visibility is typically poor, involved the use of specially designed 200m long seine nets (6m high, with a 5" mesh size) deployed after spotting one or more turtles. Deployment involved rapid encirclement of the hawksbills using local fishing skiffs, with the net subsequently being hand pulled toward the vessel or shore to recover any turtles contained therein. Turtles were equipped with Inconel flipper tags and Passive Integrated Transponder (PIT) tags for subsequent identification, and morphometric measurements (Curved carapace length and width) and skin tissue samples were collected. A total of 53 individual hawksbill turtles were captured between 2016 and 2022. Somatic growth rates of individuals hawksbill were all variables, rating from -0.39 to 17.26 cm per year of CCW, and 0.55 to 17.78 cm per year of CCL, but the high values stand for individuals recaptured in a low period of time. Identified hawksbill had minimum values of CCW of 29.5cm, and CCL of 35.1cm, and the maximum CCW of 64.5cm and CCL of 79.8cm.

GENETIC DIVERSITY AND STOCK COMPOSITION OF JUVENILE LOGGERHEAD SEA TURTLES FROM MACARONESIAN FORAGING GROUNDS

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Most sea turtle species display highly migratory behaviour, gathering in large foraging grounds (FGs) that combine individuals from widely separated rookery populations. The oceanic area surrounding Macaronesia (a region in the North-East Atlantic Ocean comprising four archipelagos: Azores, Madeira, Canaries, and Cape Verde) is an important foraging habitat for juvenile loggerhead sea turtles (*Caretta caretta*). Understanding the distribution of genetic diversity along these archipelagos plays a crucial role in defining stock composition, which is essential to build the challenging management plans for this highly migratory species. To evaluate the genetic distribution and identify the rookery origins of loggerhead sea turtles in the Macaronesian FGs, tissue samples of juvenile individuals from Azores (n = 40), Canary Islands (n = 20), Madeira (n = 63), and areas beyond national jurisdiction in the Eastern Atlantic (ABNJ - EA: n = 29) were collected between 2010-2018 and analysed within the scope of the Mystic Seas II project. We used 816 bp fragments of the mtDNA (control region) to calculate indices of genetic diversity (haplotype and nucleotide), and fixation index (F_{ST}). We also performed Bayesian mixed stock analysis (MSA), which estimates the proportional contribution of each rookery to a mixed FG. The North Atlantic loggerhead rookeries identified by Shamblin et al. (2014) were grouped into five main areas: East Florida, West Florida, Mexico, Cape Verde, and Mediterranean. Madeira showed the highest genetic diversity (h = 0.789, n = 0.0264), followed by Canaries (h = 0.747, n = 0.0249), ABNJ –EA (h = 0.704, n = 0.0244), and Azores (h = 0.588, n = 0.0237). Although the haplotype pairwise frequencies were significantly different between Azores-Canaries (p = 0.040, exact tests) and Azores-Madeira (p = 0.040, exact tests), the pairwise F_{ST} comparisons showed no genetic differences along the Macaronesian FGs, which indicates the absence of population structure. The MSA analyses indicated main contributions from rookeries in East and West Florida to Azores (57 and 35%, respectively) and Canary Islands (42 and 23%, respectively) FGs. Cape Verde rookery also contributed to around 20% of juveniles from Canaries. The loggerhead sea turtles feeding in Madeira came mostly from East Florida (62%) and Cape Verde (20%). The MSA results also showed that the major sources of individuals from ABJN-EA are the nesting colonies in East Florida (65%) and Mexico (19%). This recent analysis of mtDNA confirms that the primary source of juvenile loggerheads from Macaronesia is the nesting beaches in the northwest Atlantic, mainly East Florida. Additionally, our findings showed that the contribution of Cape Verde rookery is increasing in the Macaronesian FGs compared to previous studies. Therefore, genetic studies using mtDNA are essential to detect possible changes in the composition of the stocks over the years, which brings an important scientific

basis for monitoring rookeries and feeding aggregations and detecting population recovery or early signs of recruitment decline.

TEN YEARS OF SEA TURTLE MONITORING IN PULAU LANG TENGAH, TERENGGANU, MALASYA

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Pulau Lang Tengah provides nesting and foraging grounds for green and hawksbill turtles. However, there was a lack of information about the sea turtle populations at Pulau Lang Tengah. Turtle eggs have been a source of protein and a commercialized commodity for the coastal communities. To resolve conflicts among egg collectors in Terengganu, nesting beaches, including Pulau Lang Tengah, have been offered to the highest bidder through a tender system since the 1950s, under which the tender holder has exclusive rights to collect turtle eggs from each beach. Pulau Lang Tangah was eventually taken off the tender list when conservation efforts started. Lang Tengah Turtle Watch (LTTW), a local NGO, has been monitoring nesting activities by conducting nightly patrol primarily at Turtle Bay and Lang Sari between March and October since 2013. Nesting activities at Summer Bay, albeit a rare occurrence, are reported by the resort staff. Nests from Lang Sari and Summer Bay are relocated to Turtle Bay to deter poaching. Nests at Turtle Bay, where LTTW campsite is located, are left in situ and relocated only when there is tidal inundation and predation. Biometric data, tag numbers, and facial photographs of encountered turtle are collected for nesting population monitoring. Nest excavation is conducted post hatchling emergence. Since 2021, data loggers are deployed to measure the temperature for estimating sex ratios of the hatchlings. In-water turtles are also photographed and identified using photo-identification methods from 2017. Between 2013 and 2022, 92 green turtles (5-37 nesters per year) and 6 hawksbill turtles (0-2 nesters per year) were identified. Overall, 36,850 eggs from 417 green turtle nests (8-85 nests per year and an average clutch size of 100.96 ± 1.37) and 2,774 hawksbill turtle eggs from 25 nests (0-8 nests per year and an average clutch size of 120.60 ± 6.94) were protected. The nesting activities showed a peak every 3 years. Overall, 318 green turtle nests had an average hatching success of 75.1% (SE = 1.45) while 22 hawksbill turtle nests had an average hatching success of 65.9% (SE = 7.5). The average incubation temperature during the TSP for 35 green turtle nests in 2021 and 2022 was 28.2°C (SE = 0.07), potentially producing an average of 5.4% of female hatchlings (SE = 1.88). For in-water turtle populations, the 2 green and 6 hawksbill turtles that were recognized are distinct from the nesting populations. Although Pulau Lang Tengah has a low density of sea turtle populations, unlike turtle sanctuaries at neighboring islands, it remains one of the very few important nesting grounds for the critically endangered hawksbill turtles in Terengganu. The project hopes that long-term monitoring at Pulau Lang Tengah will contribute to the collective conservation efforts with other turtle projects to save the species in Malaysia.

BEYOND THE CARIBBEAN: MIGRATORY ROUTE OF THE *CARETTA CARETTA* LOGGERHEAD TURTLE, AN APPROACH FROM MTDNA

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The Sea Turtle and Marine Mammal Conservation Program (ProCTMM) has developed studies focused on the conservation of the loggerhead turtle (*Caretta caretta*) in the Colombian Caribbean. Sea turtles are characterized by extensive life cycles, which involve ocean migrations and exploitation of resources in different ecosystems, making their protection complex, becoming essential to know the population stocks, the connectivity between geographic areas and the genetic flow corridors. In order to evaluate these variables in individuals of the loggerhead sea turtle (*C. caretta*) established in the southern Caribbean as a nesting area, 24 sequences of the mtDNA control region were sequenced from individuals taking buccal smears. The genetic composition was structured by four haplotypes: CC-A1.4, CC-A2.1, CC-A17.1 and CC-A43.1 reported for the Atlantic and Mediterranean. The turtles that nest in the northeastern part of the Colombian Caribbean are related to organisms found throughout the Caribbean basin, Gulf of Mexico, Azores islands in the interior of the Mediterranean Sea, and Cape Verde on the western coast of Africa. These results demonstrate the existence of migrations through the Caribbean and the Atlantic Ocean that have been carried out for thousands of years, which have been possible thanks to the life history strategies of these animals. The loggerhead sea turtle has pelagic habits in juvenile stages, which allows them to float in the open sea, being able to cross the Atlantic. Once they reach European territory, they adopt neritic habits until they reach sexual maturity, at which time they return to the Caribbean where the reproductive processes occur, mainly due to a phenomenon known as phylopatria. Remote sensors, coded tags and molecular markers have shown the migratory routes used by the loggerhead turtle in relation to its life cycle stage, revealing an input for the knowledge and protection of the resource, taking into account the ecosystemic importance of these organisms.

INSIGHTS ON DEMOGRAPHY AND EVOLUTIONARY HISTORY OF THE SOUTHWEST ATLANTIC LOGGERHEAD TURTLES

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The Brazilian loggerhead nesting region in South West Atlantic (SWA) is one of the largest worldwide and have unique mitochondrial lineages diverging from others worldwide. However, despite its importance, their life history remains elusive and poorly studied. In this study, we retraced the SWA *C. caretta* life history to infer the consequences of the evolutionary processes on their current genetic makeups, spatial population structure, and contemporary and historical demography. To reach that, we sampled 189 loggerhead individuals from three SWA nesting areas, Espírito Santo, Bahia, and Sergipe, and compiled genetic information from the literature to reach a long-term survey of mtDNA (D-loop) and nDNA (15 microsatellite loci) datasets. The datasets were analyzed to test spatial population structure (AMOVA, pairwise *F*st, Geneland, Discriminant Analysis of Principal Components DAPC and Mantel), estimate connectivity, and gene flow between the nesting areas (MIGRATE-N, GENECLASS2, Monmonier´s and Delaunay triangulation), estimate the contemporary effective population size (*Ne*; NeESTIMATOR) and reconstruct the evolutionary life history (Bayesian Skyline Plot; Vareff) of the SWA loggerheads populations. The results evidenced that the SWA loggerheads present a well-defined population structure that may be related to their philopatric behavior, which corroborates the existence of specific genetic patterns linked to the geography of each SWA nesting area, with low migration rates, gene flow, and a genetic barrier limiting their connectivity. Besides, the SWA loggerheads have undergone recent bottleneck events in the last 100 generations that impacted their contemporary *Ne*, that might be promoted by environmental changes i.e., anthropogenic actions and El Nino, influencing their current *Ne* and genetic makeup. But, although the SWA loggerheads underwent bottlenecks, they present moderate genetic variation and heterozygosity that may be influenced by male-mediated gene flow contributing to the genetic maintenance and circumventing the loss of genetic diversity.

WORLDWIDE MITOGENOME DIVERSITY OF THE LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*)

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The loggerhead sea turtle, *Caretta caretta* (Linnaeus, 1758), is a species widely distributed in tropical and subtropical regions. The species is classified as globally “vulnerable” by the International Union for Conservation of Nature (IUCN) and facing a decreasing population trend. The species is highly migratory as individuals cross entire oceans during their lifespan but at the same time, they exhibit philopatry causing strong population structuring. Genetic approaches, particularly based on the D-Loop region of the mitochondrial DNA, have been used to delineate nesting populations and assess the composition of mixed aggregations at sea. Based on this mtDNA region, three clear haplogroups have been defined but two opposite phylogeographic scenarios have been considered to explain the actual worldwide haplotype distribution. The new possibility of sequencing the complete mitogenomes with whole genome sequencing data allows us to explore the potential of the whole mitochondrial DNA to clarify the phylogeography of the species. We performed whole genome sequencing (30 Gb output) on two samples from Boa Vista (Cape Verde), two samples from Sirte (Libya), and one sample from Zakynthos (Greece). We assembled and annotated the five mitogenomes and we combined our results with full mitogenomes found in the literature and publicly available from GeneBank to produce a final set of 13 mitogenomes covering the Mediterranean Sea, the Atlantic Ocean, and the Pacific Ocean. We explore the mitogenomes structure and diversity across the distribution of the species and perform phylogenetic analyses gene by gene and with the overall mitogenome. The results show first that through the whole genome sequencing we can recover a high quality mitogenome with a mean depth greater than 900X. In addition, all mitogenomes contained the same 37 genes (13 protein-coding genes, 22 tRNA genes, and 2 rRNA genes), followed by the control region. All mitogenomes have the same structure and are organized in the same gene distribution as the majority of vertebrate mitogenomes. The diversity was very variable across the mitogenome in both the coding (from $\pi = 0{,}0041$ in ATP8 to $\pi = 0{,}01636$ in ND3) and non-coding regions (from $\pi = 0$ in tRNA-Ala, tRNA-Asn, tRNA-Cys, tRNA-Glu, tRNA-His, tRNA-Met, tRNA-Pro, tRNA-Ser, tRNA-Trp, tRNA-Tyr, tRNA-Val to $\pi = 0{,}02663$ in the D-Loop). All the phylogeographic analyses (gene by gene, using the whole mitogenome and using a supermatrix tree) supported a scenario of an initial haplogroup split between the Atlantic and Pacific after the closure of the Panama Isthmus, and a secondary introduction to the Atlantic from the Pacific through the Cape of Good hope that reached the Mediterranean and western Atlantic.

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*GENOMICS OF THE SEA TURTLE COLONIZATION UNDER GLOBAL WARMING

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World biodiversity is in crisis due to global temperature rise. Marine sea turtles are particularly sensitive to climate change due to temperature sex determination, increasing hatchling mortality, and the potential constraints to colonize new areas due to philopatry. Previous studies have described an incipient colonization process of the loggerhead sea turtle (*Caretta caretta*) in the Western Mediterranean, but the mechanisms underlying the rapid increase of sporadic nests of this species in recent years are still unknown. In this research, we analyzed 8 nests laid between 2016 and 2019 along the Spanish Mediterranean coast. We analyzed several hatchlings per nest with genòmics, using a 2bRAD technique, and sequenced a fragment of the mtDNA D-Loop region from one sample per nest. The D-loop haplotypes found reveal the different origin of the nesting females, belonging to either Mediterranean or Atlantic nesting areas. Overall, we genotyped 45 hatchlings with the 2bRAD technique, and after filtering, we retained 2,291 loci shared by at least 95% of the individuals. By using parentage analysis, we detected the minimum number of breeders. Each nest corresponded to a different mother, with the only exception of two nests within the same nesting season and located 213 km apart that belonged to the same female. We also gathered data about the clutch size, hatching success, and incubation duration, which allows estimating the percentage of females in the offspring. We conclude that the rate of inferred female offspring ranges from 0% to 100% in some nests, depending on the beach conditions. Our results suggest that the increase in nests is due to the arrival of more colonizers, which can be explained by two non-exclusive hypotheses. On one hand, the increase in the number of nests may be caused by the increase in females arriving from the populations of origin, either because of the recovery of some populations or due to their feminization. On the other hand, it has been detected that sea surface temperature is increasing in the Mediterranean Sea due to global warming. This increase may favor an earlier sexual maturation of females in developmental areas and thus them nesting in nearby beaches. Regardless of the hypothesis, the possibility that individuals will return in the same beaches in the future when reaching sexual maturity, is highly probable due to the phylopatry of the species and to the high percentage of female hatchlings estimated in recent nests, which increases the probability of returning nesting females. Our results allowed us to genetically characterize the first individuals of a potential colonization. Nevertheless, detecting remigrants is necessary to confirm a nesting population on the way to becoming a resident population. In the near future, through a continuous genomic study and an appropriate genòmic baseline of this species worldwide, we will be able to identify the genetic lineage of origin of the nesting populations and understand how genetic variability contributes to this colonization in action.

COMING OUT OF THE SHELL: FIRST ASSESSMENT OF THE HAWKSBILLS FROM THE BIJAGÓS ARCHIPELAGO, GUINEA-BISSAU

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Despite their critically endangered status, there are still substantial knowledge gaps regarding the ecology, spatial distribution, reproductive success, and dynamics of hawksbill turtle (*Eretmochelys imbricata*) populations. In the Eastern Atlantic, especially in West Africa, data on this species is either sparse or absent and many of its breeding areas are still unknown. Previous genetic analysis has shown that hawksbill populations in West Africa are connected and that unidentified stocks remain. It is urgent to fill these knowledge gaps, for the effective conservation of local populations as well as the protection of this critically endangered species at a regional level. The Bijagós archipelago in Guinea-Bissau is a key area for sea turtles and a known nesting ground for hawksbills. Poilão island, situated within the João Vieiraand Poilão Marine National Park, is a major green turtle rookery. Hawksbill turtles are also known to nest there, albeit in much smaller numbers. Still, this is the largest hawksbill known regular nesting site in the archipelago, and one of the most understudied in West Africa with no population assessment made so far. We present the first extensive dataset pertaining to this hawksbill rookery aiming to provide the first overview and description of its nesting ecology, genetics, and foraging habits. From monitoring data, encompassing 2007 to 2021, one to six turtles nest yearly in Poilão, with two to twelve recorded nesting events per year. Despite irregular tagging efforts, we identified at least 20 different adult females, some returning regularly to nest for at least 12 years. Both curved carapace length (CCL) and clutch size of this nesting population are larger than others from West Africa (mean CCL 90.08 ± 4.72 cm, min. 83.5 cm, max. 102.2 cm; mean clutch size 160.81 ± 38.89 eggs). Tracking data, from five females spanning from 2018 to 2020, allowed us to describe their movements during nesting, migration, and foraging. We found an important foraging area within the Bijagós archipelago. We have also detected two haplotypes in this population also present in either other foraging areas or nesting grounds in west Africa and the Atlantic. Our study sheds light on a small but potentially important nesting population of hawksbills from West Africa, helping to fill the gaps in one of the most understudied regional populations.

*TO WHOM BELONGS THE GENOTYPE OF THE UMBILICAL CORD? EXPLORING NON-INVASIVE METHODS FOR SEA TURTLES

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The application of genomic techniques for wildlife conservation purposes is steadily increasing due to the reliability of the results generated. Genomics allows obtaining high numbers of loci from small amounts of tissue, providing the opportunity to obtain an accurate genotyping. In addition, the biologic material to perform the genetic monitoring can be obtained from minimally invasive samplings, providing genomic information at the individual and population level, without even handling the animals. However, non-invasive samplings for genomic studies present limitations. First, the difficulty of collecting samples of elusive species, and second the quantity and quality of the genomic DNA extracted. Sea turtles spend most of their life in the open ocean, making them a difficult group to obtain biological samples. Hence, nest detection is an excellent opportunity to obtain samples, especially in areas where nesting is scarce, as in the case of sporadic or emergent nesting expansions. Likewise, the common methodologies to obtain biological samples (e.g., blood collection or tissue biopsy) are often unsafe or even unfeasible to perform on newborn hatchlings. Thus, exploring new non-invasive methodologies on sea turtles is essential to improve the possibilities of studying them. Here, we describe a non-invasive sampling method and we test it for genomic studies on the loggerhead turtle (*Caretta caretta*). Here, we aim to assess if DNA from the mother or the offspring, or both, are present in either end of the umbilical cord and if data derived from these samples are suitable for genomic studies. In brief, we sampled umbilical cords from incubator-hatched individuals and from natural exhumed nests and also used multiple samples from different emerging Spanish nests in the western Mediterranean. We extracted DNA and genotyped blood samples from one of the nesting females, from different hatchlings of the same nest, as well as one umbilical cord sample. We built independent 2b-RAD libraries for both ends of the umbilical cord to explore the possible differences in their genotype. The catalogue of loci was obtained using the loggerhead turtle (*Caretta caretta*) reference genome. Then, we calculated the Percentage of Shared Genotypes (PSG) to know the levels of overlap between the genotype of the samples, comparing: 1) both regions of the umbilical cords, 2) the umbilical cords and the corresponding hatchling sample, 3) the umbilical cords and the female sample whenever available, and 4) the umbilical cords and the rest of hatchlings genotyped. We also conducted differentiation analysis to test the clustering of the samples and the umbilical cord behaviour versus the samples aggregation. Our results allow assessing for the first time, the potential of the umbilical cord as a non-invasive method for obtaining genomic data, revealing to whom the umbilical cord genotype belongs. In summary, we have obtained good-quality genomic DNA from the umbilical cord, unveiling that the whole tissue exhibits the same genotype and corresponds to the hatchling's profile.

*CONNECTIONS BETWEEN SENSORY AND IMMUNE RESPONSES AND DIFFERENCES IN THE HIGHLY CONSERVED SEA TURTLE GENOMES

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The first comparative genomic analysis of sea turtles at chromosome level was performed between the new reference quality genomes of the green sea turtle and the leatherback turtle. Not only the analysis confirmed the expectations of high levels of synteny across sea turtle species, but it further revealed extremely high levels of collinearity, also known as the order in which genes are located within chromosomes. A few regions were found to present reduced collinearity levels between both species and they were very often associated with the presence of multi copy and fast evolving olfactory receptors and immune gene families. Strikingly, multi-copy gene families were as a rule more numerous in the green sea turtle genome, possibly caused by the need for a faster adaptation to new environments and/or environments with greater variety of odorants and pathogens. Future in-depth analysis should reveal what mechanisms allow for the necessary variation in selected regions of the genome to allow olfactory receptors and immune genes to evolve and adapt over time. I will also present the current status of the reference genomes sequencing of the remaining five sea turtle species. These genomes will represent new and high-quality resources to the sea turtle community, and their analysis should show whether the same features of conservation and divergence are maintained across all sea turtle species.

FEW NESTS BIG IMPACT: VOLUNTEER PROGRAM TO DETECT SPORADIC LOGGERHEAD TURTLE NESTING IN MURCIA, SPAIN

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Murcia is a small region in the South-East of Spain (SW Mediterranean) where sporadic nesting events of the vulnerable loggerhead turtle (*Caretta caretta*) have been documented since 2015. However, at present, only three successful nests have been found in the area. Given the low nesting activity, the long coastline of Murcia (around 250 km) and its high level of urbanization, most nesting events may have gone undetected or ended up in aborted nests due to disturbance. This led the “Asociación de Naturalistas del Sureste” (ANSE), an environmental NGO, to join other local organizations in 2016 to conform a regional volunteer network, created and led by the Regional Council for the Environment of Murcia and “El Valle” Wildlife Rescue Center. Specifically, ANSE´s sea turtle volunteer group has the objectives of carrying out morning censuses during the nesting season in order to map and track eventual nesting events, but also raising awareness in the local community on the importance of conserving and protecting loggerhead sea

turtle nesting grounds. At present, ANSE´s volunteer group has consolidated a team of more than 30 volunteers who have conducted regular morning censuses for 6 years (2016-2022), fully covering 25 kilometers of coastline, reporting a nesting attempt in July 2017 and collaborating in the protection and monitoring of a nest found in July 2019 in the Calblanque Protected Area. Moreover, besides participating in awareness campaigns, the NGO started a fundraising campaign NGO started a fundraising campaign for the acquisition of three satellite tags, and "Universitat Politècnica de València" provided the funds for the tracking of Calblanque´s post-hatchlings that were released after a year in a headstarting program at "El Valle" Rescue Center. Although the number of detected nesting events in Murcia is extremely low compared to the easternmost Mediterranean nesting beaches, documenting them is of utmost importance to understand this new colonization, while protecting sea turtles amidst continuous coastal development and involving local communities in the process. However, ANSE is just a small piece of a common effort, as loggerhead turtle nesting has been reported throughout the Spanish Mediterranean and multiple entities are involved at regional and national levels, both public and private, including rescue centers and stranding networks. Nevertheless, this case it is the perfect example of how acting locally and promoting the collaboration among diverse stakeholders are essential to protect and better understand this flagship species in the Western Mediterranean.

POPULATION TRENDS AND CONSERVATION STATUS OF SEA TURTLES OFF THE COAST OF ANGOLA

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Five of sea turtle species occur in Angola's coastal waters: Leatherback (*Dermochelys coriacea*), Green (*Chelonia mydas*), Olive Ridley (*Lepidochelys olivacea*), Loggerhead (*Caretta caretta*) and Hawksbill (*Eretmochelys imbricata).* The first three of these species nesting regularly to the north of the front between the Angola and Benguela currents. Between 2010 and 2021, numbers of female turtles nesting annually in Angola were on average c. 850 for Leatherback, c. 90 for Green and c. 61,000 for Olive Ridley (the largest population of this species in the Atlantic Ocean). In this period numbers of Leatherback and Olive Ridley turtles that nested decreased, whereas those of Green Turtle were stable. There is just one record of Loggerhead Turtle nesting in Angola and none of Hawksbill Turtle. Large numbers of Green Turtle feed seasonally at three localities between the Congo and Cunene rivers. North Angola may be an important nursery and feeding area for Hawksbill Turtle.

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*LIFE-HISTORY OF *LEPIDOCHELYS OLIVACEA* MODEL: A CASE STUDY OF GUATEMALA'S POPULATIONS

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According to life-history theory, population dynamics depend on many attributes, such as biotic potential, distribution, density, and mortality, which can determine the type of population growth in nature. The available information on each population allows to estimate its population dynamics in the most precise way and with the least possible hypotheses. The virtual turtles model (V-turtles) is an individual based-model that models population dynamics for conservation or evolution studies. Using the V-turtles platform, we present at the finest scale the life history of marine turtles, specifically the population of the species *Lepidochelys olivacea* in Guatemala, using reaction norms for incubation, sex determination, embryo, subadult and adult growth, the pattern of intra- and inter-seasonal nesting for females maternal investment in eggs production and survivorship. Due to their particular situation, we used Guatemala's population, in which, for over 50 years, eggs have been relocated to hatcheries, leaving the beaches with no nests. Over this situation, 80% of the nests are commercialized in marketplaces or other localities to eat and sell, which leads us to hypothesize that only 20% of the nests laid on Guatemalan beaches remain in hatcheries. Considering that the V-turtles model allows the adjustment of the variables into different scenarios, such as human take and predation, we were able to hypothesize not only what could've happened in the past 20 years, leaving the 20% conservation quota in the hatcheries but what would be the ideal scenario to Guatemala's conditions and sea turtle conservation. The outcome of this work may help update and adjust Guatemala's current sea turtle conservation management plan, given that it may provide valuable insight into the tendency of populations according to the current and ideal management of sea turtles in this country.

LONG-TERM CHANGES IN ADULT SIZE OF GREEN TURTLES AT ALDABRA ATOLL AND IMPLICATIONS FOR CLUTCH SIZE, SEXUAL DIMORPHISM AND GROWTH RATES

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The green turtle (*Chelonia mydas*) nesting population at Aldabra Atoll was the first to be protected in the Western Indian Ocean in 1968. Continuous monitoring over most of the past five decades has demonstrated a significant increase in population size, presumably in response to protection. Here we present biometric data collected from adult green turtles at Aldabra and adjacent southern islands of Seychelles, to examine sexual dimorphism, how nesting female body size has changed at Aldabra over time, and how that change might relate to the reproductive output of the population. Based on > 4500 individual measurements over 21 years (1996–2016), we found the mean annual curved carapace length of nesting females at Aldabra declined by about 0.64 cm per decade, from 111.43 to 110.08 cm. During the same period the mean growth rate for 391 Aldabra nesting females was 0.14 cm year−1 (in individuals measured more than once at intervals of 2.8–19 years apart). Our study and others have shown that smaller females tend to produce fewer egg clutches, and some other studies have also recorded declines in mean size of nesting females

over time. These observations raise concerns that a decline in the mean body size of nesting turtles might also be accompanied by an overall decrease in reproductive output. At Aldabra, however, the decrease in mean female size was offset by larger increases in numbers of turtles nesting annually. So, the estimated total numbers of eggs laid per year at Aldabra actually increased from 1.3 million to 2.0 million between 1996 and 2016. Therefore, a decrease in mean size of nesting females has not compromised egg production for the Aldabra population. We speculate that one or both of the following factors may explain the decrease in average size of Aldabra females: a) Relatively more younger and smaller neophyte turtles may now comprise the increasing Aldabra nesting population; and/or b) Aldabra females may be reaching adulthood at a smaller size than in previous decades, perhaps due to ecosystem changes caused by climate change (which has been hypothesized as the cause of slow sea turtle growth rates documented in the western Atlantic in recent decades). Our study of sexual dimorphism involved body measurements taken opportunistically in 1982 and 1983, at two unprotected sites in Southern Seychelles where adult male and female green turtles were hunted while engaged in reproductive activities. We compared the sizes of adult females and males based on 23 and 14 weight measurements, and 107 and 33 carapace length measurements, respectively. Carapace lengths of adult females averaged 9% longer than that of males; and females weighed 25% heavier than males.

USING MOTOTOOL MARKS TO MONITOR POST-RELEASE BEHAVIOR OF STRANDED GREEN SEA TURTLES (*CHELONIA MYDAS*) ON MAUI

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Moto-tool marks are a tagging method using an alphanumeric etching on the costal scutes of sea turtles. The marks can be used to monitor migratory patterns, distribution, and post-release behavior of sea turtle rehabilitation patients. The mark has proven to be a cost-effective and accessible method to involve the community in sea turtle conservation efforts in the Hawaiian Islands. Under a collaborative agreement with NOAA Fisheries, Maui Ocean Center Marine Institute (MOCMI) maintains a stranding response hotline and responds to more than two hundred sick, injured, expired, or distressed sea turtles on the island of Maui each year. Stranding causes include interactions with fishing gear, shark predation, vessel strikes, buoyancy disorders, disease, geographical entrapment, and unknown causes. MOCMI staff biologists, interns, and volunteers respond to stranding reports to assess the animal's condition. Once evaluated, recovered sea turtles are either cleared for immediate release or admitted to MOCMI's rehabilitation center for treatment and long-term care. Upon release, each turtle receives Passive Integrated Transponder (PIT) tags in their hind flippers and an alpha-numeric etching on the fourth costal scute. Traditionally, external flipper tags have been the most widespread tagging practice to gain insight into post-release behavior. Both PIT and flipper tags are viable options but require the capture of each turtle for identification. MOCMI has adopted moto-tool marking, a non-invasive and cost-effective method for marking stranded turtles. This method was first practiced in 1990 in Hawai‘i (Balazs 1992) and includes a high-speed (20,000 rpm) dremel moto-tool and the application of non-toxic paint. MOCMI's moto-tool mark contains an "MA" for the island of Maui and a number, up to three digits following, which is etched into the carapace with a dremel. The groove is then filled in with white non-toxic paint. This mark will last anywhere from six months to one year, depending on the overall growth rate of the turtle (Balazs 1992). The mark is visible and easily identifiable from afar. Through MOCMI's re-sighting program and NOAA Honu Count Program, the community is encouraged to identify marked turtles and report them to MOCMI's website, social media channels and RespectWildlife@noaa.gov. Since beginning the sea turtle re-sighting program in 2020, MOCMI has received 1202 reports. One hundred ninety-seven individual turtles make up these 1202 re-sightings; 33 of the 197 turtles were long-term rehabilitation patients. Four cases (MA09, MA72, MA100, and M108) were selected to highlight the importance of reporting post-release activities of sea turtle patients by community members. Select cases include a severe entanglement resulting in amputation, an entanglement that did not require amputation, a long-term rehabilitation patient, and a stranded sea turtle that was cleared for immediate release. We selected these cases due to the variety of stranding severities and for the numerous times they have been re-sighted. The use of a moto-tool mark to monitor sea turtle rehabilitation patients has provided significant insight into post-release behaviors and provides an opportunity to engage the community in sea turtle conservation efforts.

POPULATION AND HEALTH ASSESSMENT OF JUVENILE GREEN TURTLES IN AN IMPORTANT FORAGING GROUND IN SOUTHWESTERN ATLANTIC OCEAN

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Conservation of long-lived marine animals depends on knowledge of demographic parameters, spatial usage, and individual-based health assessment in each developmental stage. The Paraná coast, southern Brazil, is an important foraging ground for juvenile green turtles (*Chelonia mydas*). However, the region hosts several anthropogenic activities such as ports and small-scale fisheries. Since 2014, a mark-recapture and health assessment program has been conducted in that area, and in 2018 the sampling design was improved to support demography analysis. Hence, four intentional capture expeditions were organized in 2018/2019 around Cobras Island using a specific gillnet (20x2.5 m, 30 cm stretched mesh). All caught *C. mydas* were taken on board for clinical examination and general procedures, such as curved carapace length (CCL) measurement, health assessment, flipper tagging (Inconel tags; TAMAR-ICMBio), and then they were released in the same area within two hours after being caught. The capture-recapture data were analyzed by multi-model inferences based on the information-theoretic approach. The Huggins Robust Design models were applied to estimate especially monthly apparent survival (S), emigration (ɣ"), and immigration (1-ɣ') probabilities among expeditions, and population size (N) in each expedition. The presence of external tumors and CCL were assumed as covariates. Additionally, the residency was estimated by the time between the first and last capture and site fidelity by multiple recaptures in the same site. Overall, 88 individuals were marked, from which 39 were recaptured. The median residency observed was three months, and at least nine individuals stayed in the area for more than a year; most were recaptured exactly in the same capture site (73%; n=28). The CCL ranged from 30.90 to 58.10 cm (mean±SD 38.25±5.72), and 61.36% (n=54) were initially captured with tumors suggestive of fibropapilomatosis. The tumor score (n=56) indicated that 36 turtles were moderate, 12 were lightly and eight were heavily affected. For recaptured individuals, a gradual increase in individual tumor load was observed in most cases. For demographic analysis, the global model with all covariates on survival and detection was first selected based on movement pattern (ɣ"/1-ɣ') and on substitution of the time factor by time-dependent variables for capture and recapture probabilities. All combinations of covariates were made from this structure to obtain a balanced set of models. Thus, 22 models were generated, and the final estimates were obtained through model averaging, considering their uncertainty. The most adjusted models (ΔAICc<2) suggested that only S was influenced by tumor presence and CCL (β=0,05). Annual apparent survival was calculated by taking the model estimates to the 12th power. Thus, the annual S was 0.79 (IC: 0.54–0.81) for apparently healthy *C. mydas* and 0.62 (IC: 0.47–0.64) for tumor-afflicted. The y'/y" indicated no temporary movement/displacement during the sampled period. The estimated N of *C. mydas* varied from ~131 to 54 in March/2018 and August/2019 respectively. Therefore, in the short-term, the exposition to different threats may have sub-lethal effects, impacting mostly the sea turtles' health condition. These preliminary results provide information for wider analyzes of juvenile *C. mydas* populations in the Southwestern Atlantic Ocean.

PAINTING THE GREEN TURTLE CHROMOSOME – USING A VAST ARRAY OF GENOMIC SNPS TO IDENTIFY CROSSING OVER EVENTS IN GREEN TURTLE GAMETE FORMATION

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Twenty years after its establishment, the Israeli breeding stock has finally produced its first captive nests. We have employed the 3D RAD sequencing technique for studying inheritance patterns in the green turtles. Analysis of 50 Mediterranean green turtles, including the members of the Israeli breeding stock, yielded about 30,000 informative SNPs. In order to separate between female and male genetic contribution we have built an algorithm that uses the well-distributed genomic markers to reconstruct each of the parents' pair of chromosomes. The accuracy of the algorithm depends on the number of hatchlings in a nest, without the prerequisite of the parent's DNA. Since each hatchling represents a DNA mixture of his four grandparents, we were able to follow the meiosis process in oogenesis and spermatogenesis, and the rate of crossing over. Oogenesis is clearly defined by a higher number of crossings over than spermatogenesis, where these events are more restricted to the chromosome ends. From an evolutionary point of view, this may be another indication that females play a more important role in generating genetic variability, much like their ability to store sperm.

ANALYSIS OF GENETIC DIVERSITY IN LEATHERBACK TURTLES (*DERMOCHELYS CORIACEA*) BY CONTROL REGION (D-LOOP)

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The leatherback (*Dermochelys coriacea*) is one of the six sea turtle species that nest in Mexico. This study aimed to analyze the genetic diversity of the leatherback sea turtle on Mexican beaches. Three hundred mitochondrial sequences from the control region (CR) or D-loop, of which 27 were samples from Oaxaca, Michoacán, and Baja California Sur, all from Mexico. We analyzed a total of 263 leatherback sequences available in GenBank globally. Results were obtained through bioinformatic analyzes such as BioEdit, Mega, PopArt, DnaSP, IQtree, and FigTree. We identified twenty-eight previously described haplotypes and one new haplotype. The samples from Mexico showed six previously identified haplotypes. The interspecific analysis (0.1) did not identify a separation within this species. While the interspecific distance was between 0.162 and 0.264. The above results were also supported when a p and K2P distance analysis was performed, which showed that leatherbacks, compared to the rest of the sea turtles, showed a separation between the leatherbacks, the family Cheloniidae, relative to that exhibited by the outgroup the desert tortoise (*Gopherus berlandieri*). Regarding genetic diversity, the analysis of the sequences showed diversity between the same population in the case of the Pacific, Atlantic, and Indian oceans with haplotypic diversity greater than 0.6, considered as a single population. In addition, we obtained a phylogenetic tree showing how the two families of sea turtles are separated and how the Dermochelyidae node is entirely divided from the rest of the species (family Cheloniidae) as expected, with all leatherback sequences clustered on the same main branch. This study contributes knowledge on the critically endangered Mexican Pacific leatherback, which can be used when developing regional management and conservation plans. Finally, a DNA barcode of this region was also obtained. In conclusion, CR genetic diversity analyses revealed independent leatherback populations in major nesting areas and highlighted shared haplotypes between turtles from Mexico and the rest of the world.

GENOMICS OF LOGGERHEAD TURTLES: TOWARDS A BASELINE

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Genomic techniques are becoming widely used in conservation offering an unprecedented resolution to evaluate the behaviour, reproductive success and impact of different threats on endangered species. The price reduction of massive sequencing has allowed many research groups to work with genomic techniques and for species with small genomes or, when enough funding is available, pangenomes can be obtained with whole genome sequencing to capture the whole diversity of the species. Yet genomic reduction techniques need to be used for species with large genome sizes, such as sea turtles, where we want to know the origin of stranded individuals, juveniles in foraging areas or breeders in emerging nesting beaches to scientifically inform management decisions. Different methodological approaches could be used, but the same methodology needs to be used in a given species for cross-comparison across its distribution by building a common baseline. We present the results for 397 loggerhead turtle samples, from feeding and breeding grounds as well as sporadic nesting's, using 2b-RAD base selective adapters for adjusting the number of loci for reduced budgets. We compare samples from 11 nesting beaches on the eastern Mediterranean and from Boa Vista nesting area in the eastern Atlantic with samples from western Mediterranean feeding grounds and sporadic nests in the Western Mediterranean. We have sequenced 6.1 million reads per individual (range 2.3-20.6 million reads) and mapped them to their recently available genome in GenBank (GCF_023653815.1). After filtering, we identified 8,109 SNPs present in more than 70% of the samples. We observed that samples from Boa Vista clustered together and were well separated from the cluster of the samples from Mediterranean nesting areas. Furthermore, many samples from foraging grounds and sporadic nesting fall within the Mediterranean cluster while others could not be assigned indicating an incomplete baseline. The time is ripe for conservation genomics to provide scientifically based information to stakeholders, managers and politicians on the impact of even distant anthropogenic threats in reducing population sizes, contributing to take appropriate management measures for the conservation of this and other endangered species. Our study highlights the need to build global collaborative networks to compare the results across all RMUs for this highly migratory species that does not know about borders.

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*GENETIC COMPOSITION AND ORIGIN OF GREEN TURTLES FORAGING AT THE BANC D'ARGUIN NATIONAL PARK, MAURITANIA

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Understanding the migratory connectivity of populations is essential to identify threats and design effective conservation strategies. Genetic tools have been key to unravelling movements and connectivity of marine turtles, yet, significant data gaps remain, namely for the origin of Eastern Atlantic green turtles, limiting our understanding of Atlantic-wide connectivity. Here we assess the genetic composition of green turtles foraging in the Banc d'Arguin, Mauritania, one of the largest foraging aggregations in the Atlantic. Sea turtles were reported to occur at this site and traditionally were regularly consumed by the local human population, but until recently nothing was known about their age-structure and origins, other than that some females nesting in the Bijagós archipelago (Guinea-Bissau) migrated to the Banc d'Arguin. From 2018 to 2021 we extensively sampled green turtles at the Banc d'Arguin with the help of traditional fishers (the Imraguen). Turtles were captured using gill nets, brought onboard fishing boats, measured for curved-carapace-length (CCL) and a biopsy was collected for genetic analysis (epidermis from shoulder region). We used two genetic markers from the mitochondrial DNA (mtDNA) – D-loop (~735bp) and STR (short tandem repeats of 'AT', ~200bp) – to assess the genetic structure between Atlantic green turtle foraging aggregations and to estimate the most likely origin of turtles foraging at the Banc d'Arguin through Bayesian one-to-many mixed stock analysis (MSA) weighted by nesting population size. Besides the Banc d'Arguin, we also include novel data from several rookeries belonging to the Southern Atlantic green turtle subpopulation. We captured 323 green turtles, of which 57.9% were juveniles (CCL $\leq$ 65 cm), 30.7% were subadults (65 cm $<$ CCL $<$ 85 cm) and 11.5% were adults (CCL $\geq$ 85 cm). Mean CCL was 65.3 $\pm$ SD 15.4 cm (range: 36.5 – 115 cm CCL). We identified six D-Loop haplotypes from 304 individuals, with a clear dominance of CM-A8.1 (91.8%), followed by CM-A5.1 (6.3%) and four rare haplotypes: CM-A1.4 (0.3%), CMA6.1 (1.0%), CM24.1 (0.3%) and CM36.1 (0.3%). For the STR we found 13 different haplotypes, reinforcing the usefulness of this marker to uncover genetic variability. Two MSAs, one for each genetic marker, revealed that green turtles at the Banc d'Arguin include individuals originating from the south Caribbean (7.2% DLoop, 4.6% STR) and Ascension Island (2.8% DLoop, 5.6% STR) as well as a majority (89% DLoop, 87% STR) from Guinea-Bissau, West Africa. The contribution of Sao Tome was negligible with the DLoop (0.3%) but higher with STR (2.2%). Our results show that the Banc d'Arguin hosts green turtles from widespread origins across the Atlantic, playing an important role for the species at the scale of the Atlantic Ocean basin, and likely of global importance.

*RECENT DESIGN IMPROVEMENTS FOR A STEREO-VIDEO CAMERA EQUIPPED UNOCCUPIED AERIAL VEHICLE FOR MEASURING SEA TURTLES, AND OTHER MARINE FAUNA

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Many biologists have adopted UAVs to conduct aerial surveys of sea turtles because of their ability to survey large regions of the ocean with a bird's eye view that is quite unlike boat-based or in-water studies. Building on the accessibility of UAVs to scientists, we recently introduced a proof-of-concept system to mount a stereo-video camera (SVC) to a UAV to facilitate collecting length data of marine objects. Our SVC-UAV system has several benefits for aerial study of marine fauna, mainly the ability to measure animals below the surface, as they are diving or surfacing, does not require altimetry, and the relatively low cost. In addition, the SVC-UAV system has reasonably good accuracy (mean absolute error 4.4 +/- 0.99 cm for sea turtles), is unbiased, and can measure animals up to about 1 m depth. In this research, we will present some recent hardware and software updates to the original prototype SVC-UAV, highlighting the most relevant design improvements for scientists. First, we are testing a lightweight, stand-alone, SVC system that can be mounted to a smaller (i.e., one that can fit in a backpack for field work) quadcopter, using carbon fiber and 3D printed components, and integrated stereo-video cameras. Our software improvements include automated digital camera syncing and calibration that can be done in the field, and a user-friendly graphic interface. In terms of video post processing, we are working to implement machine vision methods to conduct object measurements, reducing uncertainty due to human error, and subsequently increasing accuracy. Finally, we are also investigating optical methods to reduce measurement error and statistically analyze how error may increase with water depth. In all, the SVC-UAV is useful for conducting aerial surveys of sea turtles to collect morphometric data where in-water or capture-based surveys are logistically challenging or infeasible.

HAWKSBILL AND GREEN TURTLE NESTING BEACH SURVEYS AT MONA ISLAND, PUERTO RICO

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Mona Island is a protected Natural Reserve that is an important breeding ground for hawksbill and green turtles in the northern Caribbean. Nest count surveys have been conducted on Mona with varying coverage since 1974 and by us since 1996. Hawksbill nesting activity expanded strongly until 2016, then stabilized, with a total of 1088 nests recorded for the period from August to December 2021. Nesting by green turtles is also increasing but on a lesser scale; in 2021 we recorded 38 nests for the species. Local marine turtle protection methods include the installation of fencing to reduce access of nest-predating feral pigs to the nesting beaches, the rescue of stranded nesting turtles, and the regular presence of survey personnel that deters poaching. The impact of recent storms and hurricanes on the nesting beaches of Mona Island is discussed.

ORIGIN OF LEATHERBACKS (*DERMOCHELYS CORIACEA*) AT FEEDING GROUNDS OFF THE RÍO DE LA PLATA IN SOUTH WESTERN ATLANTIC

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The leatherback turtle, *Dermochelys coriacea*, like other species of marine turtles, undertakes long-distance migrations between tropical/subtropical nesting beaches and distant temperate foraging areas. Globally, leatherback status according to IUCN is listed as Vulnerable, but the Southwest Atlantic subpopulation is classified as Critically Endangered. Satellite telemetry studies have demonstrated that the coastal waters off South America provide important feeding grounds for large juveniles and adult leatherbacks in the western South Atlantic. For the past 20 years, the NGO Karumbe in Uruguay and PRICTMA in Argentina has investigated the biology and habitat use of this species in waters off the Rio de la Plata estuary, a nearshore foraging area with jurisdiction shared between Uruguay and Argentina. Previous genetic studies using Mixed Stock Analysis (MSA) with mtDNA data have demonstrated that the leatherbacks foraging off Uruguay and Argentina come primarily from the West African breeding populations, primarily the large Gabon rookeries. New approaches are now available to assign stock origin of individual turtles using nDNA analysis with greater precision. This study builds on previous mixed stock analysis, by incorporating nDNA genotyping using a suite of 16 informative microsatellite markers combined with mtDNA analysis of an expanded sample set (n= 130), including 56 new samples from stranded animals of the Río de la Plata. Results of the MSA are generally consistent with previous findings, with an estimated 90% belonging to the West Africa rookeries. It was unclear whether the minor contributions estimated by MSA from Caribbean and South African rookeries were statistical artifacts resulting from shared common mtDNA haplotypes among these source populations. Results from our individual assignments using nDNA genotype data confirmed that at least five turtles originated from Caribbean rookeries, providing new insights into potential connectivity between the breeding populations in the Northwest Atlantic and the foraging populations in the Southwest Atlantic. Taken together these findings advance our understanding of the connectivity between these breeding and foraging areas on opposite sides of the ocean in the South Atlantic.

LEATHERBACKS SEA TURTLES IN THE SOUTHEAST ATLANTIC OCEAN: MULTIPLE THREATS ANALYSIS

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The southeast Atlantic (SEA) is a major breeding and development area for the leatherback sea turtle. The major nesting beaches are located in Gabon and the Republic of Congo, with nesting taking place from November to April (peak in December and January). Mark-recapture data and satellite tracking studies have shown that leatherbacks nesting on Central African beaches migrate to multiple foraging areas off the coast of Africa and South America and are exposed to multiple threats. To better understand and quantify the major threats and potential impacts to leatherback populations in the SEA, we conducted a threats analysis. Threats were identified and classified for the different life stages and ecosystems inhabited by sea turtles into a matrix. We considered 8 life stages: nesting females, eggs, hatchlings, neritic juveniles, oceanic juvenile, neritic adult, and oceanic adult. We grouped all identified threats into six main threat categories: fisheries bycatch, resource use (direct and indirect use), habitat alteration, pollution, species interaction, and climate change. Additionally, as threats vary depending on the ecosystem inhabited by the turtles, we incorporated three environments: 1) terrestrial (beach), 2) neritic and 3) oceanic. Annual mortality was estimated for each life stage/ecosystem for each threat. As the information is very heterogeneous and it was difficult to assign actual mortality rates and we used a range of mortality values based on the best available information (e.g. published data, projects database information and expert opinion): 0 (no evidence of mortality); >0 (mortality has been documented or is likely to occur; however data are insufficient to estimate mortality); 1-100 (low mortality); 100-1000 (medium mortality); >1000 (high mortality). Sublethal effects for certain threats and life stages were also highlighted. Results indicated that fisheries bycatch (i.e. longline, trawl and gillnets) represent a major threat for leatherbacks in the SEA, with the gillnet fishery as the main source of mortality for adult turtles. In addition, nesting females, eggs and hatchling stages are subject to mortality by illegal harvest and habitat alteration. Gaps remain in our knowledge and understanding of the status and ecology of leatherback turtles in the eastern Atlantic and the regional population is categorized as Data Deficient on the IUCN Red List, but this study has highlighted significant threats and conservation priorities that effective management strategies need to urgently address.

*SEA TURTLES' IDENTIFICATION USING DEEP LEARNING AND MULTIMEDIA APPROACH

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Although sea turtles play an important role in the conservation of marine ecosystems, their populations have been declining in recent decades. To plan how to manage the preservation of sea turtles, useful data is needed, such as migration patterns, distribution, and growth rates. One of the ways to obtain this data is flipper tagging, and subcutaneously injected passive integrate transponder (PIT) tags. The drawback of these techniques is the fact that it is invasive, and the flipper tags it is not permanent. Moreover, it increases the likelihood of the turtle getting accidentally caught in a fishing net. To contribute to the development of non-invasive techniques for the preservation and identification of species and individuals; artificial intelligence methods such as artificial neural networks, computer vision, image processing and mathematical algorithms are used. This paper presents a non-invasive technique for the identification of sea turtles in their ecological situations using optimized deep learning and multimedia content processing methods. Indeed, we obtain the sea turtle head region analyzing its unique morphological characteristics. The YOLO (You Only Look Once) convolutional neural network model was optimized and trained with transfer learning from the weights of the YOLOv5X model and with a reduced size database. Having a result of 89% accuracy in detecting and segmenting the sea turtle head region for the test database. Then, we emphasize the morphological traits of the segmented regions of the sea turtle heads, through the use of a group of image digital filters that suppress the low and high frequencies, where the necessary parameters were adjusted to obtain a better representation of the traits and flakes of the turtle head, we use the OpenCV library. Finally, we identified individual sea turtles. The morphological pattern for each sea turtle is formed by the characteristic points of the features and scales of the head of the turtle. Identification is performed by comparing the morphological pattern of the turtle to be identified with the morphological patterns in the generated database. The performance of the three filters implemented in the second stage was evaluated, with an accuracy of 92% for the use of the Threshold filter, 88% for the Prewitt filter and 86% for the Roberts filter. More traits and flakes were distinguished, when threshold filter was used. This proposed non-invasive technique achieved high performance in the identification of individual sea turtles under ecological habitat conditions using digital images.

STEREO-VIDEO CAMERA DERIVED MORPHOMETRICS TO ESTIMATE BIOMASS USING SEA TURTLES HELD IN REHABILITATION FACILITIES IN FLORIDA, USA

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Obtaining in-water sea turtle morphometrics is essential to understand the relationship between species and their environment. Moreso, morphometrics can serve as important health indicators, are linked to resource availability, and can influence biomass. Given that sea turtles are typically distributed sparsely throughout their habitats, it is challenging to acquire morphometric data. In-water capture-based methods are quite invasive and can be dangerous to both the researcher and sea turtles. However, stereo-video cameras (SVCs) can non-invasively obtain in-water morphometrics, which can be used to estimate sea turtle biomass in the wild and serve as a solution to this issue. Notably, it is unclear which suite of morphometrics

will yield the most accurate estimates of biomass. In addition, it is important to validate SVC-based measurements of all the morphometrics. Here, we investigate SVC morphometric measurement accuracy and statistically evaluate the best combination of morphometrics to estimate biomass remotely using sea turtles held in rehabilitation facilities. From June 2021 to August 2022, we measured various sea turtle body morphometrics of seventy individuals across three species including *Lepidochelys kempii* (n=33), *Caretta caretta* (n=28), and *Chelonia mydas* (n=9) and were obtained both manually and remotely to compare body measurements. Candidate sea turtles were relatively healthy and resided at rehabilitation facilities located in Florida, USA. Manual measurements were recorded using metal calipers, whereas remote measurements were conducted using the SVC and SeaGIS EventMeasure software. Prior to the survey season, the SVCS was calibrated underwater using standardized methods to ensure accurate remote measurements. Body morphometrics included straight carapace length and width, head length, width, and depth, front and rear flipper lengths and widths, body depth, and mass. All SVC-based morphometric parameters were validated compared to physical measurements. The SVC morphometrics were then used to formulate species-specific generalized linear models to predict sea turtle biomass, using the (AICc) Information-Theoretic Approach to model selection. For all species of sea turtle, results indicated that straight carapace length was included in the top-ranked model to accurately estimate biomass (percent bias for *Lk*: -0.10% ± 0.20 SE, *Cc*: -0.63% ± 0.29 SE, *Cm*: -0.8% ± 0.50 SE), followed by head depth (percent bias for *Lk*: -5.58% ± 1.25 SE, *Cc*: 2.56% ± 3.22 SE, *Cm*: -2.41% ± 1.48 SE). In addition, for *L. kempii*, body depth (-11.50% ± 2.73 SE) was included in the top-ranked model. In comparison to *C. caretta*, the AICc-selected model demonstrated the width of the left rear flipper (-3.52% ± 0.94 SE) as top-ranked. Incorporating up to two additional morphometrics, in addition to SCL, improved biomass estimation. In the future, this research will be applied to wild sea turtles to remotely estimate biomass during in-water surveys. To our knowledge, this is the first application of SVCs to collect morphometrics to estimate biomass for any species of sea turtle, beyond length-weight relationships. Our approach will enable researchers to non-invasively facilitate the investigation of ecological, physiological, and environmental relationships with sea turtle biomass.

RECENT TREND ON LEATHERBACK NESTING TURTLES ON THE SOUTHERN NICOYA PENINSULA, COSTA RICA: IS IT TOO LATE?

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In the Eastern Pacific, the leatherback turtle (*Dermochelys coriacea*) population is classified as Critically Endangered according to the IUCN due to the sharp decline that the population has been facing in the last decades. In the past, the illegal extraction of eggs and fisheries bycatch, have been reported as the primary causes of this decline. In the 90s, Costa Rica had one of the largest nesting sites for this species in the Eastern Pacific along with other sporadic nesting beaches. The Rescue Center for Endangered Marine Species (CREMA) monitors four sea turtle nesting beaches in the Southern Nicoya Peninsula Costa Rica; San Miguel Costa de Oro, Bejuco, Corozalito, and previously Caletas (until 2015). Prior to 2004, San Miguel and Caletas were described as nesting beaches for this species. This study aims to summarize the historical data of leatherback nesting from 1998 to 2022 on the beaches monitored by CREMA. Data were collected during morning and night patrols including the date, nesting event category (successful or unsuccessful), marked turtles (pit and Monel tags), Curved Carapace Length (CCL), and nest *emergence success*. Over the last twenty-four years, 185 leatherback nesting events have been documented in the area,

with Caletas as the main nesting location (n=150, 81.1%), followed by San Miguel (n=19, 10.3%). Most of the nesting events were recorded in 2004 (n=36, 19.5%), with December as the month with more encounters (n=45, 25.1%). The majority of the nesting events were successful (n=111, 60%), while 27% (n=50) were unsuccessful and 13% (n=23) were unidentifiable. Seventeen turtles were tagged either with pit or Monel tags, and thirteen of them were documented as renesters. Additionally, two leatherback turtles tagged in other Costa Rican projects (Camaronal and Ojochal) were found nesting in Corozalito (2016) and San Miguel (2013). The mean CCL was 143.7 cm ±10.9 (n=64; ranged from 110 cm to 175 cm). Over the monitored nests (n=39), only nine of them had more than 50% emergence success. Overall, leatherback nesting events in the Southern Nicoya Peninsula show a slow but clear recession over the years, concurring with the decline of the Eastern Pacific population. Although in the past these beaches were considered areas with occasional nesting events of this species, this is not the actual situation. In light of these results and the trend that this population has been following, it is essential to take action now and apply real solutions to avoid the extinction of this species in the Eastern Pacific. In particular, further efforts among stakeholders and short and long-term conservation actions are needed to restrict fisheries effort in essential habitats for leatherback turtles, particularly along identified transboundary migratory corridors, and attain an overall reduction of fisheries effort.

RECENT TRENDS IN THE GUANAJA NESTING RECOVERY PROJECT, GUANAJA, HONDURAS

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The Bay Islands are an archipelago in the Honduran Caribbean. The three main islands are Roatán (the largest and most commercially developed), Utila (the smallest, yet most densely populated), and Guanaja (the second largest, and the least developed and least inhabited). Prior studies by the Protective Turtle Ecology Center for Training, Outreach, and Research, Inc. (ProTECTOR, Inc.) demonstrated almost no regular nesting of hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*), nor loggerhead (*Caretta caretta*) sea turtles on Roatán, although nesting of hawksbill and green turtles has been monitored on Utila since 2011. Guanaja's turtles, however, remained unstudied and unprotected. In contrast to both Roatán and Utila, the island of Guanaja has experienced far less coastal development due to the lack of tourism. The majority of the island's beaches remain essentially undisturbed, with little lighting, housing, and with the majority of the coastal vegetation intact on which nesting hawksbill, green, and loggerhead have previously been reported. The island also boasts fringing reef habitats in which juvenile hawksbill have been reported. Despite its undeveloped turtle nesting habitats, concerned Guanajans appealed to ProTECTOR reporting that the majority of nesting turtles and their eggs were being lost to poachers. In 2018, ProTECTOR, Inc. partnered with Green Island Challenge (GIC) to begin the Guanaja Nesting Recovery Project (GNRP) in which the two organizations began meeting with municipal government agents, training local community members on how to measure and flipper tag nesting turtles, and providing all ages environmental education. Volunteer opportunities with the project have involved over 300 of Guanaja's youth. Since 2018, we have seen a trend toward increasing nesting of sea turtles on as many as 9 of Guanaja's 15 beaches. Nest poaching has decreased from 80% to 3%, successful nests have increased sevenfold, and roughly 22,780 total hatchlings have made it to sea. Hawksbills have increased from 13 to

20, greens from 4 to 7, and loggerheads from 3 to 5. This initial data opens the discussion to Guanaja's role as an important nesting area, with the potential to compensate for the decline of nesting in the more developed islands. Ongoing monitoring, flipper tagging, satellite telemetry, and genetic studies are critically needed to further evaluate the nesting dynamics of all three species on Guanaja, and throughout the Bay Islands. Importantly, this project reflects best practices in international partnerships, and is a model for successful community led conservation and collaborative research initiatives.

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*GROWTH RATE AND ESTIMATED AGE AT SEXUAL MATURITY IN THE MARINE PROTECTED AREA OF ALDABRA ATOLL, SEYCHELLES, FOR TWO SYMPATRIC, IMMATURE TURTLE SPECIES

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Many marine vertebrates are highly migratory, are long-lived and take several years to reach sexual maturity. These qualities make them particularly vulnerable to changes in the environment, and sea turtles are a prime example. Crucial demographic parameters, such as growth and the age which individuals reach sexual maturity, can be affected by the environment, and therefore influence population growth. Human impacts, such as development and nutrient run-off, alter marine ecosystems. Another influence is the increasing number of individuals from recovering populations, as has been seen with green turtles (*Chelonia mydas*) and sea grass habitats. This emphasizes the importance of understanding species' demographic parameters in more pristine habitats, that are not as influenced with direct human impacts. We estimated key population parameters with a 40-year (1981–2021) capture-mark-recapture dataset from the protected UNESCO World Heritage Site, Aldabra Atoll, Seychelles, for immature green turtles and hawksbill turtles (*Eretmochelys imbricata*). Recapture events were used with a minimum 11-month period. This revealed a mean annual growth rate of 3.2 ± 1.5 cm/year for green turtles (n = 75 recapture events) and 2.8 ± 1.4 cm year/year for hawksbill turtles (n = 110 recapture events). A non-monotonic growth rate was seen for hawksbill turtles, and green turtles showed no significant growth-size relationship. The mean annual growth for green turtles per 10-cm size class was highest in the larger size classes, as has been seen in a few sites in the Atlantic and the Pacific. Hawksbill turtle growth rate was highest in the larger size classes then declined in the largest size class. Per the growth functions, green turtles and hawksbill turtles may spend >8 and 18 years, respectively, using Aldabra as a foraging ground. This study provides growth rates from a long-term monitoring programme in the Western Indian Ocean, allowing comparisons to be made to other regions. Age at sexual maturity estimates were > 30 years for green turtles and approximately 50 years for hawksbill turtles. Improvements of these models and further contributions within the West Indian Ocean will allow further understanding of these recovering populations and help strengthen population models.

OPERATIONAL SEX RATIOS AND REPRODUCTIVE DYNAMICS OF MALE GREEN TURTLES (*CHELONIA MYDAS*) ON THE MISKITO COAST, NICARAGUA, AN IMPORTANT ATLANTIC FORAGING GROUND

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Adult sea turtle sex ratios are usually studied at mating areas off nesting beaches. However, in populations that present migrations between foraging and nesting grounds, these estimates account only for reproductively active individuals. This ratio of reproductively active males to reproductively active female sea turtles, also called the operational sex ratio, present an annual variation possibly caused by fluctuations in foraging ground productivity. Female sea turtles store sperm, and males that copulate with females in-route to nesting grounds may never complete migration, which further skews operational sex ratios estimated off nesting beaches. Consequently, to better understand changes in sex ratios over time, baseline and long-term studies of operational sex ratios are needed, specially at foraging grounds. A legal harvest on the Caribbean off Nicaragua exacts an annual toll of over 6,000 green turtles (*Chelonia mydas*). In 2020, we studied gonads of 79 green turtles harvested off the Miskito Cays, northeast Nicaragua, one of the main Atlantic foraging grounds for this species. We determined green turtle sex, maturity, and reproductive status based on the visual inspection of gonads as described by Miller and Limpus (2003). We also conducted histological analyses of male green turtle gonads. Using this information, we quantified the proportion of males that were reproductively active in this green turtle population and compared this value to the number of reproductively active females in the same year. We used an evidential approach to test which of four variables (CCL, width of seminiferous tubules, and teste and epididymis volume) best predicted male green turtle reproductive status. We fit four logistic regressions, each with a single predictor related to gonadal measurements and body size and compared models using Schwarz Information Criterion. To assess how much support there was for the initial best model for male green turtle reproductive status, we ran 10,000 non-parametric bootstrap replicates. The proportion of reproductively active male green turtles harvested off the Miskito Cays was higher than the proportion of reproductively active females in 2020. This highlights that males may have shorter remigration intervals than females in this green turtle population. In histological preparations, testes of reproductively active male green turtles showed enlarged seminiferous tubules with abundant sperm in the lumen. Macroscopically, testes of reproductively active males were more voluminous, wider, and thicker than testes of reproductively inactive males. Additionally, models using teste volume were the most accurate to predict probabilities of male green turtles being reproductively active. Assessing sex ratios of the adult segment of sea turtle populations is crucial to understanding how these species will respond to the warming of the planet in light of continuing harvest. With the present study, we quantified for the first time the operational sex ratio for green turtles at foraging grounds off Nicaragua. We also provided an important comparison between macroscopic and histological analyses of gonads to determine male green turtle maturity and reproductive status. Finally, we used this information to provide a tool for better assessing male green turtle reproductive status based on different gonad measurements.

*EXPANDING THE SEA TURTLE GENOMICS TOOLBOX TO CHARACTERIZE DIET AND GUT MICROBIOME IN THE SOUTHEASTERN UNITED STATES

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DNA metabarcoding is a sequence-based method that is increasingly being used to characterize complex, mixed samples comprising DNA from multiple individuals and diverse species. Researchers can address numerous biological questions and target different taxonomic groups of interest by using different DNA barcodes and primer pairs of varying specificities. We used DNA metabarcoding with multiple primer sets to characterize diet composition and gut microbiome of sea turtles that stranded in Florida, USA. In a pilot study of 39 green turtle (*Chelonia mydas*) gut content samples from 2009-2015, we optimized sample processing protocols, compared the efficacy of six diet-specific primer pairs (CO1, 18SV1-V3, 18SV4, rbcL, UPA, ITS), and conducted gut microbiome sequencing (16S rRNA gene). The CO1 and 18SV4 primer sets produced the most dietary amplicon sequence variants and unique taxonomic classifications and were the only primers to amplify taxa from all three kingdoms relevant to green turtle diet (Animalia, Chromista, and Plantae). Sequencing data showed that, in addition to plants, diet included many soft-bodied organisms (e.g., jellyfish and ctenophores) that are difficult to identify using traditional visual techniques. Additionally, CO1, 18SV4, and 18SV1-V3 sequencing results identified numerous parasite taxa. The 16S sequencing results indicated that the gut microbiome was dominated by the bacterial phyla Firmicutes and Bacteroidetes. Building on our pilot project, we subsequently used CO1 and 18SV4 metabarcoding and newly-trained taxonomic classifiers to characterize Florida sea turtle diets with colon swabs from 180 green turtles, 48 loggerheads (*Caretta caretta*), and 41 Kemp's ridleys (*Lepidochelys kempii*) that stranded in 2016-2019. Diet metabarcoding results were compared to visual identification data for the same turtles and integrated with microbiome results and necropsy data to better understand relationships among diet, microbiome, and health (e.g., fibropapillomatosis). Conservation, management, and recovery of sea turtles will be enhanced through a better understanding of these relationships and their ties to habitat and human activities. Integration of metabarcoding techniques into ecological studies not only complements diet data collected through visual identification but can also allow for use of a single, minimally-invasive swab sample for characterization of diet, parasite, and microbiome taxa. Established metabarcoding protocols typically improve taxonomic resolution and reduce time investment per sample, and we recommend their continued use to better understand sea turtle ecology and health.

DNA BARCODE ANALYSIS OF THE ENDANGERED GREEN TURTLE (*CHELONIA MYDAS*) IN THE BREEDING GROUNDS OF BADAGRY, LAGOS, NIGERIA

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The Nigerian coastline is long and heavily populated. It is also the nesting site of a huge numbers of species that are dependent on that ecosystem for their reproduction cycle. Artisanal fishermen and the local populace are dependent on these species as a cheap and alternative source of protein. The Sea Turtles having been classified as threatened by the IUCN are a major part of that ecosystem. Currently, there is however a dearth of research works on the species. The usefulness of the DNA barcoding region (CO1) of the mitochondrial genome is used to analyze populations *of Chelonia mydas* along Badagry beach in Lagos,

Nigeria. Seven adult samples were obtained and CO1 sequences were generated from them. Twenty-seven more sequences were harvested from the GenBank of which only Five were used in the final analysis either because there were errors (insertions, deletions or stop codons) or because of redundancies. A Six hundred and Eighteen (618bp) indel free sequences was obtained. The intraspecific divergence in the Nigerian samples was very low, being between 0.00 and 0.002, while the intraspecific distance when the other sequences were added increased a bit ranging from 0.002 to 0.54. Neighbor- joining phylogenetic tree produced two distinct clades, with the Nigerian samples being clearly mapped into one with bootstrap value of 100% while others mapped into another. The best substitution model is TN93+G. The Taima index was also very low indicating a population with very low genetic divergence. The average codon usage also followed the pattern A (29.3) > C (28.7) > T (27.3) > and a G(14.8). An expansion of the sampling points and increase number of samples is recommended for a more robust ideal of the relatedness within and without.

EAST ISLAND, 5 YEARS LATER: SHIFTS IN KEY DEMOGRAPHIC PARAMETERS FOR HAWAIIAN GREEN SEA TURTLES (HONU) FOLLOWING THE LOSS OF THEIR PRIMARY NESTING ISLAND

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From 1973-2015, NOAA's Marine Turtle Biology and Assessment Program (MTBAP) in Hawai'i carried out baseline monitoring of green sea turtle (honu) nesting activity at the population's primary nesting site, East Island, at Lalo (French Frigate Shoals) in the remote Papahānaumokuākea Marine National Monument. In 2015, a status review of the population found it was highly vulnerable as 96% of nesting was concentrated at a single, low elevation site. As a result, from 2016-2018, MTBAP began collecting more holistic and contemporary data at East and nearby Tern Island, respectively, to improve NOAA-produced population models and trend analyses. We employed intensive monitoring efforts to saturate tag females and (basking) males as well as generate data on vital rates and hatching productivity. Alarmingly, in 2018, East Island was completely washed away by a hurricane. Nesting surveys are now only conducted on Tern Island, a WWII-era former airport with dilapidated structures and crumbling seawalls that entrap and kill nesting females and hatchlings each year. With the inability to monitor honu abundance at the index nesting beach for this population, MTBAP's data collection approaches now include quantifying the consequences of the turtles' shift to suboptimal habitat (e.g., nest success, entrapment rates). Here we present updates to the project in light of these new challenges, including changes to demographic parameters and neophyte abundance at Lalo. Changes in nesting demographics (i.e., nest success, clutch frequency, inter-nesting interval) on East and Tern Islands were analyzed before and after the hurricane to understand honu plasticity to disturbance events. For example, mean hatching and emergence success decreased by 20% and 17%, respectively. As the atoll's largest remaining island, lower nest success on Tern Island may have grave implications for population recovery. As a result of the long-term efforts to tag nesting females at East Island (i.e., since 1973), many of the turtles observed nesting on East Island in 2017-2018 had been previously tagged. In contrast, when MTBAP increased survey effort on Tern Island starting in 2017, a majority (>80%) of the turtles tagged had never been tagged before. The higher abundance of "new" neophyte turtles at Tern Island indicates limited movement (i.e., strong nesting site fidelity) of tagged nesting turtles between East and Tern Islands prior to Hurricane Walaka. These findings also suggest that historical data collection efforts which focused primarily on East Island may have led to underestimates of the nesting sub-population utilizing Tern Island (and other islets in the atoll). The results of this project are critical inputs for the assessment and conservation of this entire population and may shed light on changes in vital rates coinciding with habitat loss in other locations around the world.

THE MEDITERRANEAN GREEN TURTLE BREEDING STOCK GENOME STUDY – A RARE OPPORTUNITY TO LEARN ABOUT EVOLUTION, REPRODUCTIVE BEHAVIOR AND POPULATION DYNAMICS

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The Israeli breeding stock was established two decades ago, aiming to support the diminishing population of green turtles along the Israeli shores. The breeding stock was initially constructed by hatchlings from two nests – one from the south and the other from the mid-north beaches of the country. Here we present the use of the RAD sequencing technique, which yielded about 30,000 informative SNPs for studying green turtles of the Mediterranean. This vast amount of genetic variation enabled calculating the genetic distance between any two individuals, determining paternity and identifying relatives like siblings and half siblings. We have identified that while one of the breeding stock families included full siblings, two different males formed the other family. In order to separate between female and male genetic contribution we have built an algorithm that uses the well-distributed genomic markers to reconstruct each of the parents' pair of chromosomes. The accuracy of the algorithm depends on the number of hatchlings in a nest, without the prerequisite of the parents DNA. Multiple nests of the same females, as determined by mtDNA haplotypes, enable the identification of the female chromosomes. Since each hatchling represents a DNA mixture of his four grandparents, we were able to follow the meiosis process in oogenesis and spermatogenesis, and the rate of crossing over. Oogenesis is clearly defined by a higher number of crossings over than spermatogenesis, where these events are more restricted to the chromosome ends. From an evolutionary point of view, this may be another indication that females take a more important role in generating genetic variability, much like their ability to store sperm.

*WHOLE MITOCHONDRIAL GENOME SEQUENCING TO IMPROVE POPULATION GENETIC INFERENCE AND PHYLOGENY OF MEDITERRANEAN LOGGERHEAD TURTLES

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The loggerhead sea turtle (*Caretta caretta*) exhibits female natal philopatry, with episodic breakdowns in this fidelity when founder individuals colonize new sites for reproduction. This behaviour on one hand shapes population structure, on the other increases the species range. Within the Mediterranean Sea, the major rookeries are in the eastern part of the basin and the Libyan are thought to be the most ancient ones, of Pleistocenic origin. Sporadic nesting is recently occurring also in the western basin, likely a shift in the distribution range due to the global warming. Genetic approaches have been for decades a tool for population and evolutionary studies of this species. In particular, mitochondrial DNA (mtDNA), which is maternally inherited, has been used to characterize the populations as genetically distinct rookeries and to reconstruct the phylogeny of these matrilines. However, the limited resolution of mtDNA fragments used as traditional genetic markers (mainly the control region), has hampered progresses in population genetics and phylogeography, due to the widespread sharing of common haplotypes. Whole mitogenome sequencing can now overcome these shortcomings. In this study we sequenced the complete mtDNA of 34 adult loggerheads and 27 among unborn embryos or dead hatchlings collected from different nests along the Italian coasts, including occasional and minor undescribed nests. We performed a whole genome sequencing with low nuclear coverage (1X) in order to obtain high coverage mitogenomes (> 100 X). Mitotypes were assigned as variants of the correspondent control region haplotype names. Genetic diversity indices were computed, Maximum Parsimony and Bayesian phylogenies were constructed with partitioned mitogenomes and including complete mtDNA sequences available from online databases. All mitogenomes were reliably reconstructed. All our samples assigned to the Atlantic/Mediterranean haplogroup II, with the sole exception of one adult loggerhead of Atlantic origin (haplogroup IB), sampled at sea. As other authors recently reported, haplogroup II resulted to cluster together with Pacific haplogroup IA. On the whole, a recent (Pleistocenic) and rapid radiation of haplogroup II results from our phylogenies, respect to the divergence from the other haplogroups. Our data do not support positive selection within the Mediterranean, since most of the non-synonymous substitutions occur among haplogroups and not within haplogroup II. Thanks to mitogenomic, we identified 23 different mitotypes, instead of only 10 control-region haplotypes. Samples carrying the same and most frequent mtDNA control region haplotype (CCA2.1) were assigned to 11 different mitotypes. The rare Libyan - Israelian control region haplotype CCA2.9 also showed two distinct variants and resulted to be basal to all the other mitotypes within the

same haplogroup. Mitotype CCA20.1.1 stemmed from one variant of CCA2.1, both described in Calabrian nests, which may suggest a local origin. Our work represents the first mitogenomic dataset for Mediterranean loggerheads, including previously undescribed nesting sites. It improves the resolution of lineages in the Mediterranean basin respect to traditional control region marker, splitting a highly shared haplotype in different mitotypes, and will certainly strengthen future mixed-stock and phylogeographic analyses of *C. caretta*, now declining in many parts of the world.

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*MIXED-STOCK AGING ANALYSIS REVEALS VARIABLE GREEN SEA TURTLE MATURITY RATES IN A RECOVERING POPULATION

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Quantifying demographic parameters and vital rates, such as somatic growth rates, time to maturity, and reproductive longevity, is important for understanding basic biology and effective management of threatened and endangered populations such as sea turtles. To address these knowledge gaps, we applied skeletochronology to analyze and compare somatic growth rates and variation in life-history traits such as age and size at sexual maturity for 65 green turtles (*Chelonia mydas*) in the eastern North Pacific Ocean, along the west coast of the United States; turtles belonged to ≥2 nesting subpopulations that differed in body size (mean nesting size). Our results found that green turtles that nest in the eastern North Pacific spend approximately 5 years in the oceanic stage before recruiting to nearshore habitats, males may be smaller and younger than females at maturation ($\bar{x}$ = 17.7 ± 5.5 yr vs. 28.0 ± 8.2 yr), and younger age at sexual maturity was associated with smaller size at sexual maturity, suggesting that mean nesting body size could be reflective of maturation timing for subpopulations. Smaller body sizes for females nesting at Michoacán, Mexico (continental rookeries, reported mean 82 cm CCL), yielded a younger predicted age at sexual maturity ($\bar{x}$ = ~17 yr) compared to females from Revillagigedo Islands, Mexico, which displayed larger body sizes (reported mean 94 cm CCL) and had an older predicted age at sexual maturity ($\bar{x}$ = ~30 yr). We consider possible mechanisms driving the observed divergence in life-history traits, including the possibility that earlier maturation (reduced generation length) for turtles in the Michoacán nesting subpopulation may be a response to intense harvesting in the past 50 years, and consideration of such anthropogenic impacts is warranted by population managers. Finally, our results indicate green turtles moved into nearshore neritic habitats at a young age (4–6 yr), emphasize the importance of protecting neritic habitats along the western United States and northwestern Mexican coasts, and encourage the incorporation of variable maturation time in population recovery assessments. (This study was published in January 2022 in the Journal of Wildlife Management, doi.org/10.1002/jwmg.22217.).

*RECENT DECLINE OF THE GREEN TURTLE NESTING POPULATION AT TORTUGUERO, COSTA RICA

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Assessing trends of different life stages for wildlife populations presents important opportunities to manage the conservation of threatened species. For marine turtles, most trend assessments are based on long-term monitoring of nesting aggregations, providing critical information on rookery dynamics across seasons. Tortuguero, Costa Rica, is the green turtle's (*Chelonia mydas*) largest nesting colony in the Atlantic Ocean. We present an updated nesting trend over 50 years of monitoring and conservation efforts at Tortuguero. We conducted weekly surveys recording nest numbers and used a generalized additive model (GAM) fitted for each monitored season separately to predict daily nest tallies and estimated annual nest numbers as the sum of these. We modelled the long-term trend in nest numbers with a Bayesian GAM with a cubic regression spline basis, fit to the estimated annual nest counts for 1971 – 2021. Finally, we examined spatio-temporal patterns in nest counts along the beach by fitting a GAM with a two-dimensional spline. Nest estimates presented large interannual variations ($\bar{x}$= 78,695; SD± 6,727; range: 7,004 – 186,640 nests/yr). Tortuguero's nesting trend increased steadily over the first 37 years. However, since 2000 this growth slowed gradually until 2008, when the curve plateaued and began to trend downwards. Despite this, Tortuguero remains the largest aggregation of nesting green turtles within the Caribbean. Phenomena occurring across the population's distribution and at several life history stages influence Tortuguero's nesting trend. Thus, a decreasing trend at Tortuguero may be considered a warning sign for the Greater Caribbean green turtle metapopulation.

*IN-WATER SURVEYS AT MONA AND MONITO ISLANDS, PUERTO RICO, 1992-2022

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We have conducted annual in-water surveys at Mona and Monito Islands starting in 1992. The reefs and cliff walls around these islands harbor extensive foraging and reproductive habitats for juvenile to adult hawksbill and green turtles. We highlight some of the results obtained during our surveys, with emphasis on the relative absence in recent years of small, recruitment-sized hawksbills in all surveyed habitats. During a total 1682 hours of in-water surveys we made 2798 hawksbill captures (56% of which were local recaptures) and 140 green turtle captures (7% local recaptures). Only very few instances of turtles captured that had been tagged elsewhere were recorded. Sizes of captured hawksbill turtles ranged from 20.0 to 91.8 cm SCL. The density of the hawksbill turtle aggregation is greatest at Monito Island, where somatic growth rates are also highest, due to apparent abundant availability of prey sponges there. Local mobility of immature hawksbills is limited, with only a few recorded instances of shifts between habitat types. Adult male hawksbills, a focus of our turtle captures, have shown to be breeding and foraging at Mona Island for up to 28 years.

WHERE DO SEA TURTLES FORAGE IN THE MEDITERRANEAN SEA? FILLING THE GAPS OF KUŞADASI BAY (TURKEY) WITH A MIXED STOCK ANALYSIS

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Sea turtles are highly migratory species, feeding and breeding sites can be very distant, and individuals from the same breeding areas can use different foraging grounds. Considering their vulnerability and conservation concern, it is essential to establish connections between foraging and nesting areas to link threats at seas to the affected populations. However, gaps in the knowledge of these connections may jeopardize management and conservation efforts. The Mediterranean hosts nesting populations of loggerhead *(Caretta caretta)* and green *(Chelonia mydas)* sea turtles. Previous studies have determined the origin of loggerhead turtle individuals in most known Mediterranean foraging areas, although studies on green turtle foraging areas are much scarcer. The origin of turtles foraging in the Aegean Sea has not been addressed, remaining a significant knowledge gap for both species. Kuşadasi Bay is a foraging zone in the Aegean Sea inhabited by turtles all year round. In this bay, samples from both species were collected during 2017-2021. We genotyped 44 samples of green turtles *(Chelonia mydas)*, with sizes ranging from 11 to 85 cm CCL, using a pattern of four mitochondrial DNA (mtDNA) AT short tandem repeats (STRs) with varying copy numbers. We also genotyped 79 samples of loggerhead turtles *(Caretta caretta*), with sizes ranging from 43 to 81 cm CCL, using a segment of the mtDNA D-loop (control region). A Mixed Stock Analysis (MSA) showed that turtles from both species come mainly from the Turkish nesting populations, with the loggerheads coming mostly from western beaches and the green turtles from easternmost beaches. These results are consistent with published satellite telemetry studies, stable isotope analysis, and hatchling dispersion modeling. We statistically compared the MSA genetic results in adult and juvenile foraging grounds with particle dispersal study to infer hatchling movements to test the Learning Migration Goal Theory. Finally, we delineated the foraging routes in the Mediterranean, combining all the previous studies of Mediterranean foraging grounds with our Aegean Sea results. This study highlights the importance of using genetic tools to identify the origin of sea turtles. However, more data is needed to fill the information gaps and correctly infer the foraging migration routes within the Mediterranean.

*ESTIMATION OF GREEN TURTLE *CHELONIA MYDAS* SOMATIC GROWTH FROM A LONG-TERM MARK-RECAPTURE PROGRAM IN THE SOUTHWESTERN ATLANTIC OCEAN (33°-35° S)

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Quantifying somatic growth rates and the age at maturation remain high-priority research areas in sea turtle population ecology. Capture−mark−recapture (CMR) of turtles in-water on their foraging grounds are common worldwide, but some regions are still unrepresented, as the South Atlantic Ocean. Moreover, extracting information on migration patterns from CMR is critical for conservation measures. In this line, the objective of this study is to characterize the CMR program and to describe green turtle growth in the Southwestern Atlantic. We do so by combining a long-term CMR program with statistical tools to better characterize green turtle growth. Green turtles were captured by the NGO Karumbé as part of a long-term study on the abundance and habitat use in the east coast of Uruguay (-33°S). Turtles were captured alive with set nets while feeding over rocky and sandy bottoms. Curved Carapace Length (CCL-notch-to-tip) was measured for each turtle using a flexible tape (error = 0.1 cm) and straight carapace length (SCL) were estimated. All turtles were tagged with Inconel flipper tags. We also considered tagged turtles found stranded along the Uruguayan coast. From January 2002 to October 2022, there were 2765 green turtles registered in 3257 capture events. Of these, 321 turtles were captured between at least one (n=255) to 7 times (n=1). We also include turtles with tag scar but we couldn't identify by photo-ID (n=9). Straight carapace length at first capture ranged from 27.4 to 61.8 cm (mean±SD 37.4 ± 4.9 cm, n= 302) coincident with the fact that the zone is used as a feeding ground for juveniles. Weights ranged from 1.8 to 28.5 and the Body Condition Index was 0.6 to 1.77 at the first capture. Recaptures that occurred 180 days or less after initial capture were removed to avoid large errors in the estimation of growth rate. The remaining 122 recaptures were recorded on average 341 days apart (mean value ± 502 days SD, range 198–2927 days). The growth rate of juvenile green turtles was on average 1.29 cm year^{-1} (mean ± 1.04 SD, range -1.03–4.29). The largest growth rate (4.29 cm year^{-1}) was recorded for a turtle of 36.6 cm SCL at initial capture, which was recaptured after 425 days with an increase of 5 cm in the CCL. The greatest recorded change in carapace size between captures was observed for an individual of 31.6 cm SCL, which was recaptured after 2165 days with an increase of 22.4 cm in the CCL (equivalent to a growth rate of 1.79 cm year^{-1}). Using quantile regression (τ=0.95) to avoid confounding effects, we estimated the Von Bertallanfy growth parameter as k=0.08 and an asymptotic length of L_∞= 75.17 cm. Our results of growth coefficient are similar to previous estimates for juvenile green turtles but with a smaller L_∞. Together with these results, it is expected to evaluate hypothesis about growth using machine learning techniques to disentangle seasonal migration behavior that will add to our understanding of immature stages dynamics in the South Atlantic green turtle aggregations.

USE OF GENETIC ANALYSIS FOR SPECIES AND STOCK IDENTIFICATION OF SEA TURTLE BYCATCH IN CHILE

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There is an ongoing global need to monitor and mitigate fisheries bycatch in artisanal and industrial fisheries. Ideally, experienced, trained observers are placed on vessels to collect and record standardized information on sea turtle bycatch. However, it is generally difficult to hire and retain skilled observers able to go to sea for months at a time, and for the small-scale artisanal fisheries it is usually not possible to accommodate a dedicated observer, so collection of bycatch information requires cooperation of captains and/or fishing crews to collect information as best they can. Often species identification is not possible or reliable for the hard-shelled species. Use of digital or disposable cameras can provide photos in order to record or confirm species of sea turtles encountered. Video Monitoring Systems show promise for observing bycatch, but have yet to be implemented in Chile and present practical and operational challenges for widespread use. Genetic sampling is a simple, low-cost and widely used means to obtain direct information on sea turtle bycatch. We present results of samples collected from fisheries bycatch in Chile from 2016-2019. Skin samples were collected on-board and preserved in vials of saturated salt or ethanol for later analysis. We also included samples collected from strandings. We confirmed correct genetic species ID for all the bycatch samples identified in the field as loggerheads based on mtDNA sequences, however 21% (4 out of 19 total) of the samples from turtles recorded as green turtles were loggerheads, and 38% (3 out of 8 total) of turtles recorded as olive ridleys, were green turtles based on mtDNA sequences. Additional nDNA analysis will rule out possibility that these are hybrids. All of the confirmed green turtle bycatch and strandings belonged to the eastern Pacific Distinct Population Segment (DPS) or Regional Management Unit (RMU), with 9 can be further assigned to the Galapagos nesting population (MU) based on unique mtDNA haplotypes, and 2 to Mexico. Three of the four confirmed olive ridleys were from the eastern Pacific nesting populations, and one was from the western Pacific. Of two leatherbacks samples, we determined one was from the western Pacific, and the other from the eastern Pacific nesting populations based on mtDNA and nDNA (microsatellite) analysis. All the loggerhead samples originate from the southwestern Pacific nesting populations. We discuss implications of using this approach to improve the accuracy of species identification and additional information on fine-scale origin in bycatch and stranding monitoring.

*SEX RATIO ESTIMATION OF GREEN SEA TURTLES (*CHELONIA MYDAS*) AT FORAGING SITES IN THE GALÁPAGOS ISLANDS

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Despite global conservation and research efforts, green sea turtles *(Chelonia mydas),* continue to face threats that impede population recovery, with climate change being one of the main causes. Rising temperatures have led to the warming of nesting sites globally and due to temperature-dependent sex determination (TSD) in *C. mydas,* the majority of populations currently consist predominantly of females. Therefore, our understanding of sea turtle demographics in relation to climate change is central to evaluate population resilience but is still lacking information, particularly in feeding areas. In this study, green sea turtles at Galápagos feeding grounds were sexed using blood plasma hormone concentrations. A total of 79 turtles were sampled at five different foraging sites covering five Galápagos bioregions. Individuals were sexed via the analysis of testosterone concentrations in extracted blood plasma samples using a commercially available ELISA test kit. We found that sex ratios were significantly different from an unbiased sex ratio (1:1) across all sites, except at Wolf Island and Fernandina Island, with no statistical difference between life stages. However, the overall sex ratio for the archipelago did not differ significantly from a balanced 1:1 ratio, although a slight excess of females was observed. Our results suggest that the resident Galápagos population may not be seriously compromised. Additionally, analysis of testosterone levels detected un-expected elevated concentrations in immature males, possibly providing a sign of early sexual maturation. The estimated size where tail elongation appears to begin within this study did not coincide with the size at sexual maturity determined via hormone, which may support the idea of immature individuals attaining early sexual maturation, additionally this could be related to the black morphotype morphology on green sea turtles. It appears that due to its unique climatic conditions, Galápagos still supports a healthy sex ratio and could serve as a climate change refuge for *C. mydas*. Future research may increase the sample size and monitor the resident population over long-term to confirm this climate change refuge hypothesis.

POPULATION STRUCTURE OF EASTERN PACIFIC GREEN TURTLE (*CHELONIA MYDAS AGASSIZII*) FROM THE NORTH OF SINALOA, MÉXICO

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Sea turtle foraging areas are considered as congregation sites of these reptiles in different stages of their lifecycle. The north of Sinaloa is known as an important feeding area for the Eastern Pacific Green turtle within the Gulf of California, since it has particular physical and biological characteristics, suitable for the development of this species. For years we have worked together with fishing communities in the region for monitoring and conservation. During the years 2011 to 2018, 124 *C. mydas agassizii* individuals were captured, in order to know their population structure. For this, biometric data such as size and weight of the organisms captured were taken. Additionally, the physical condition of each organism was evaluated and the body condition index (BCI) was calculated to assess the health status. The Straight Carapace Length (SCL) presented a mean value of 60.28±8.8 cm (29.0-74.0) and a Curved Carapace Length (CCL) of 63.77±9.8 cm (31.5-79.0), while the weight presented an average of 32.01±11.9 kg (2.5-59.0), so the population is composed of juvenile and sub-adult organisms. Due to the sizes recorded, it was not possible to determine the sex of the organisms, since they had not reached the size of sexual maturity for this species; only two males were identified that had evident sexual dimorphism. The BCI presented a mean value of 1.27±0.16 (0.90-2.12), so it can be considered that the captured organisms had a very good BCI (BCI>1.2=Very Good). The results obtained from the BCI, accompanied by the physical evaluation, show that the black turtle population in the foraging area of northern Sinaloa for the past eight years has been healthy. In addition to this, it can be inferred that there is the enough food availability in the foraging area.

SOCIAL, ECONOMIC AND CULTURAL STUDIES

MONEY TALKS: AN ECONOMIC VALUATION OF MARINE TURTLES IN THE ASIA-PACIFIC REGION

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Marine turtles face many threats and are declining in many parts of the Asia-Pacific region, where overexploitation (i.e. use and trade) is considered one of the main anthropogenic threats. While turtles provide many economic benefits to people and ecosystems, these values are not well quantified. This study used economic modelling and a global household survey to measure part of the economic value of marine turtles, expressed as the public's willingness-to-pay (WTP) for the continued health and existence of marine turtle populations. The survey focused particularly on six countries in the Asia-Pacific region (China, Fiji, Indonesia, Malaysia, the Philippines and Vietnam) and additionally received responses from over 80 countries (total n=7,765). We found that a high proportion of households (82% on average) expressed a positive WTP for turtle conservation, and that the projected donation amounts are substantial. The median WTP for ensuring stable marine turtle populations, adjusted for demographic differences between the survey sample and the general population, is estimated at US $79 per household per year. When this figure is extrapolated across more than 576 million households in the Asia-Pacific region likely to be willing to pay for turtle conservation, the total value is estimated at US $45.7 billion per year. A subsequent scenario analysis revealed that annual economic welfare loss resulting from policy inaction (the 'status quo') was estimated to be US $39.6 billion per year, whereas the potential welfare gain from taking policy action to conserve, manage and protect marine turtles was estimated at US $54.6 billion per year. These results present a powerful economic justification for decision makers to align environmental policies and budgets with Asia-Pacific peoples' stated WTP for turtle conservation.

BRIDGING PEOPLE AND SEA TURTLE CONSERVATION THROUGH A CIRCULAR ECONOMY: A LONG-TERM MODEL FOR SUSTAINABILITY

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Fundacao Projeto Tamar, Brazil

The Projeto Tamar has experienced great success protecting sea turtles in Brazil since its creation in 1980. Currently, four populations of turtles (*Caretta caretta*, *Eretmochelys imbricata*, *Lepidochelys olivacea*, and *Dermochelys coriacea*) that occur along the Brazilian coast show a consistent growth trend. At the same time, the *Chelonia mydas* population is stable. This recovery is a reflection of successful research and protection strategies in nesting and foraging grounds combined with initiatives that promoted fishermen's and local communities' participation in sea turtle conservation within 22 localities distributed

across eight Brazilian states. The main feature of Fundacao Projeto Tamar's community participation is to respond to evolving threats to sea turtles from social interfaces through an adaptive environmental management approach. Diversity and flexibility of practices are critical to enable effective local responses to existing or potential threats to sea turtles. Social inclusion initiatives developed during the early stages of Projeto Tamar in the 1980s remain an important strategy for conservation, becoming an organic part of the institution's sustainability strategy. Such initiatives include support for t-shirt manufacturing and artisan groups formed by women from traditional communities, like fishermen, *caiçaras*, *quilombolas,* and indigenous groups. They were implemented in locations with low social and economic incentives but are strategic for conservation. Over the past 40 years, these actions promoted the establishment of a circular economy, where social inclusion and sustainability became interdependent. Sustainability is linked to the income from six visitor centers and 12 Tamar stores, providing resources for conservation activities. The stores are supplied with an average of 13,000 pieces/month by two Tamar-owned clothes manufacturing facilities. Nine artisan groups sell their crochet, sewing, embroidery, and beads (necklaces and bracelets) work through the stores with nearly 3,000 pieces are sold per month. The profit from artisan product sales returns in full to the craftsman/craftswoman. This system contributes to the income of about 60 families working in the clothing factory and around 100 families from artisan groups. Furthermore, this circular economy model became so robust that even in challenging situations such as the COVID-19 pandemic, it was possible, through some adaptations, to maintain the benefits to the communities involved including also sustainability for conservation activities. The clothing factory managed to retain 50% of their employees. Efforts focused on producing cotton protective masks, and artisan sewing groups assisted production. Currently, activities are returning to a normal routine, and self-sustaining actions already contribute to 75% of the resources required to perform regular conservation activities. Therefore, social integration incorporated into consolidated sustainability activities is a successful strategy for the long-term maintenance of sea turtle conservation activities.

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*A COLLECTION OF ECUADORIAN ARTISANAL FISHERS' PERSPECTIVES ON OCEAN CONSERVATION

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Artisanal fisheries in Ecuador provide both critical nutrition and financial security for many in the region. At the same time, these small-scale fisheries account for substantial quantities of bycatch in the Eastern Tropical Pacific, thus endangering many marine species in the biodiverse waters of Ecuador. Government-proposed conservation technologies and policies have been largely ineffective due to lack of fishermen acceptance and implementation. These conservation techniques will likely continue to be ineffective until fishermen's perspectives are acknowledged and their priorities integrated into local and national policies. This study aims to understand the relationships between the ocean, marine organisms (e.g. eastern Pacific leatherback sea turtles) and fishermen to 1) improve the livelihood of artisanal fishermen, 2) help increase marine wildlife populations in the area and 3) foster relationships between fishermen and governmental agencies to create bottom-up and top-down conservation policies. A total of 120 individual surveys were completed in four of the five coastal provinces based on accessibility and current safety trends: Santa Elena (53 surveys), Manabí (50 surveys), Esmeraldas (16 surveys) and El Oro (1 survey). The survey contains Likert-scale and open-ended questions to understand 1) fishermen's relationships to the ocean, 2) how fishermen define conservation, 3) fishermen's conservation priorities, 4) the relationship between fishermen and marine animals and 5) how fishermen feel about fishing technologies, policies and regulations in Ecuador. Results are being analyzed for patterns and will be compiled into a sample easy-to-read report, which also includes recommendations for future policy proceedings that are grounded in effective environmental psychology and behavioral science principles. According to preliminary results, 86% of fishermen noted fewer target fish and almost 50% said the profession was becoming increasingly dangerous (e.g. more violent piracy). Nearly 90% of fishermen attribute changes to fish stock and safety to anthropogenic threats, and the majority called for a combination of new policy implementation and radical reshaping of existing policies. Interestingly, only about a third thought artisanal bycatch was an issue, despite studies indicating otherwise. Many blamed bycatch on industrial fishing, highlighting prominent tension between the two fishery industries. Overall, fishermen thought generally positively of marine animals, as well as technologies (e.g. LED lights) and policies (e.g. Marine Protected Areas) aimed to reduce biodiversity loss. Many fishermen voiced reluctance to work with the government to come up with community-based and locally-informed solutions. However, 95% were excited to work with scientists and nonprofit organizations to ameliorate artisanal fishing's threats to fish stock and bycaught animals. The survey's preliminary analysis highlights the importance of designing effective, collaborative and inclusive solutions to fisheries bycatch to prevent the extirpation of East Pacific leatherbacks and the decline of four other sea turtle species in the region. Moreover, this study indicates community-based interventions will likely be more durable over time, as fishing communities are a source of pride and the majority of fishermen reported willingness to work individually and collectively to reduce their impact on local ecosystems.

WOMEN AND CONSERVATION OF SEA TURTLES IN TORTUGUERO

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Sea Turtle Conservancy

Tortuguero community was established more than 60 years ago between freshwater canals and a 33-kilometer beach, where 4 species of sea turtle nest. The most abundant is the green turtle (*Chelonia mydas*), which plays an important role in the life of more than two thousand people living in Tortuguero, who are dedicated to sea turtle-centered tourism. In Tortuguero, to conserve sea turtles, a tour-guide system promoted since the 50s was created with the arrival of Archie Carr. This system has evolved over the decades, and currently tour guides with turtle observation training request a permit from the Tortuguero National Park every afternoon and pay for the Spotters Program, which consists of a group of people looking for turtles on the beach for tourists. Around this system work resources have been created in hotels, restaurants, service stores, transport, etc. This study identifies women who work in this tourism and conservation industry, as well as the challenges they have face. The study also addresses alternatives to the current tourism and conservation system that have been proposed to achieve equal opportunities between men and women, which currently do not exist. A total of 20 interviews were conducted with approximately 15 women in different occupations such as: biologists, local guides, STC Juniors assistants, park rangers and spotters, and approximately 5 men in positions of power that could generate change. One of the main challenges faced by women in Tortuguero are family burdens, such as the care of children and older adults, cooking and cleaning the home, which greatly impairs their opportunities to train, or participate in conservation activities or even be available for night work schedules. This situation is reflected in the very low percentage of women guides, women trackers, women park rangers or women biologists. These are jobs that involve night and daytime hours, in addition to training outside Tortuguero. At the same time, these jobs are the best paid. It is important to mention that in addition to the challenges mentioned, the possibility of receiving workplace harassment is increased in these jobs, which is an issue that has not been addressed by local authorities or the community in general. This is reflected in cases of family violence, which is a common occurrence in some families. Finally, although there are job opportunities for men and women (guiding, administration, managerial positions, and field work) in this sea turtle conservation system, they are neither equal nor fair. It is necessary to change this situation so that more women can participate and get involved in the conservation of sea turtles. Among the proposals for the projects is investing time and money in the issue of gender equality, working on it at home and in schools, having more flexible hours and supporting women's businesses. Women are a fundamental part of this conservation work since it is mainly they who cook the turtle meat, in addition to teaching their children habits that can improve or harm the conservation of sea turtles.

NOT EVERYTHING THAT SHINES IS GOLD, NOT EVERYTHING THAT IS SAID TO BE ECOTOURIST IS SUSTAINABLE. THE CASE OF SEA TURTLES IN MEXICO

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Ecotourism is an activity that seeks to preserve the environment and promote the socioeconomic development of the community in which it takes place. In Mexico, there are four tourist activities with sea turtles (release of hatchlings, sighting of females, sighting of sea turtles and swimming with sea turtles), which are regulated by NOM-162-SEMARNAT-2012 and article 420 of the Mexican Penal Code, this to guarantee your protection and good management, unfortunately, not all turtle camps or service providers follow these laws. A newspaper investigation was carried out, analyzing the reported photographs documented in Guerrero, Oaxaca and Quintana Roo, finding irregularities in their practices, such as: 1) Retention of hatchlings for days to guarantee that the tourist sees them, which interrupts their imprint. Also, releases at inappropriate times, which increase the mortality rate and handling of these without gloves, leaving them exposed to infections and diseases. 2) Sighting of females with crowds of people, use of white light and flash photography, causing the females to return to the sea without completing their reproductive cycle. 3) Uploading turtles to boats so that people kiss them and take pictures with them, which bothers and damages the specimens, in addition to the fact that boat traffic can generate impacts on the turtles. 4) For the activity of swimming in feedings and reproduction areas, it was found through surveillance tours by the Procuraduría Federal de Protección al Ambiente (PROFEPA) that more than double the number of people established within the authorized area was exceeded, for so this activity had to be suspended. Based on the evidence collected, we can establish that the concept of ecotourism is still not clear in Mexico, because sometimes priority is given to the economic benefit that can be obtained from the species, over its conservation; This is why, complementing the concept of ecotourism, more environmental education programs are needed, as well as greater coordination between government sectors, local communities and professionals in charge of wildlife, in order to guarantee good ecotourism.

UNDERSTANDING THE COMMUNITIES PERCEPTIONS, VALUES AND BELIEFS AS IMPORTANT FACTORS TO CONTRIBUTE TO SEA TURTLES CONSERVATION IN NORTHERN MOZAMBIQUE

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Local knowledge and religion have the potential to contribute positively to the conservation of sea turtles in coastal communities around the world. In Mozambique sea turtles have been protected by law (12/2002, de 6 de Junho) since 2002. Therefore, coastal communities are still using sea turtles for diverse purposes such as food and cultural beliefs. However, it is important to note that there are some cultural beliefs or religions that have concerns or myths related to sea turtles which can be considered as strengths to the conservation strategies of these animals. Therefore, our objective was to understand what is the knowledge, the culture and religious beliefs of coastal communities of Cabo Delgado, Northern Mozambique and how this information can be used to contribute for sea turtle conservation strategies. The research was conducted based on the Social-Ecological-Systems (SES) collaborative research approach. The use of social-ecological-system methods resulted in collecting qualitative and quantitative insights of local knowledge, existing actions, values that can be used to contribute for strategic planning as well as identify gaps to possibly suggest implementation of awareness for sea turtle conservation. To collect the data was used a combination of the key methods such as surveys and questionnaires; key informant interviews; focus groups; in-depth interviews; conversations and informal interviews. This method aims to co-produce knowledge (scientific, local, practice-based) in collaboration with stakeholders. This facilitates the appreciation of community viewpoints, and potentially to gain a more comprehensive understanding of possible contribution of the coastal communities on sea turtle conservation. The study was conducted in 13 neighbourhoods of Pemba and our sample size and frequency was defined based on the total number of residents in each neighbourhood with an interval of confidence level of 95% and an estimation error of 5%.

*TURTLEOPOLIS—APPLYING BLANCHETTE'S SUGGESTIONS ABOUT INDUSTRIAL HOG PRODUCTION ANIMALITY TO LIFE IN TORTUGUERO, COSTA RICA

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Blanchette's 2020 book *Porkopolis* details how hogs and people are intimately intertwined with work and life in North American industrial pork production towns. He details how humans shape hog bodies by intervening in reproduction, growth, and health, and he illustrates how the hog is made and remade through relations with humans, and via human relations more generally. Blanchette simultaneously argues that humans are also made and remade through their relationships with hogs. This includes impacts on human bodies, labour/work, and use of technology, with some more easily imagined than others. Further, he details the hogs' influences on human social relations, family life, leisure, and more. In this paper, I build on concepts and relationships in *Porkopolis* (2020). I focus on Tortuguero, Costa Rica, a village centred on sea turtle conservation and tourism for over 30 years. I argue that Tortuguero can be understood as Turtleopolis—a place where humans and sea turtles are inextricable intertwined, exerting powerful influences on each other's' lives, roles, possibilities, and outcomes. Here, I focus on impacts to the human side of this relationship. I examine the turtle's role in reshaping individual and village notions of space, place, identity, community. This includes related normative and legal designations of activities as acceptable or unacceptable. I examine the rise of Tortuguero as Turtleopolis, and consider the sea turtle's powerful reshaping of work, life, wellbeing in the village. I emphasize changes related to human quality of life, and to the two dominant and inseparable industries in the area: conservation and ecotourism. I do this by applying the concepts in Blanchette's Porkopolis (2020), and complementing these ideas with relevant ideas from political ecology and "more-than-human" studies. In addition to detailing parallels between Porkopolis and Turtleopolis, I point where and how the turtle in Tortuguero operates differently from the hog in Blanchette's Porkopolis (2020). Via a theoretical application of Blanchette's work to Tortuguero, this paper calls us to recognize the work that sea turtles contribute to shaping our relationships with them and each other, particularly at sites renown for turtle populations, turtle conservation, and/or turtle tourism. This paper contributes to sea turtle conservation social science in that it offers a new framing of our relationships with them, and theirs with us.

*BEYOND CONSERVING SEA TURTLES: EMPOWERING WOMEN AND GIRLS IN STEM EDUCATION AND ECONOMIC INDEPENDENCE

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The Fabien Cousteau Ocean Learning Center (FCOLC) supports and facilitates the Nicaragua Sea Turtle Conservation and Women Empowerment Program in Leon, Nicaragua. The program's core team have been collaborating on conservation initiatives in the Isla Juan Venado Nature Reserve since their first meeting in 2006. There are no replacements for the trust and friendship that has been built over the years and how this special relationship affects the success of the current program. Biophysical, institutional, and human dimensions science are the key components of the program. Biophysical information consists of monitoring both nesting sea turtles, a hatchery, and physical characteristics of the nesting beach. Institutional aspects of the project include the complex association of governmental and non-governmental entities partnering to enhance the protection of the nature reserve and its resources. The human dimensions science component of the project is centered on women empowerment. Women manage and coordinate themselves, volunteers, and youth engagement in the monitoring of nesting beaches, hatcheries, reporting, and community engagement. The human dimensions of the project include the social constructs of the multiple layers of governmental and non-governmental entities, and key players interested in the success of the project: local community, Sutiaba indigenous peoples, towns people, mayor's office, university staff and students, city, county, national police, park rangers, environmental protection offices, tourists, and the non-profit FCOLC. The FCOLC is clear about their role in supporting and facilitating the efforts of the project team in educating and conserving sea turtles and their habitats through science-based research, collaboration, advocacy, empowerment, and funding support. The project has been successful in garnering local champions to ensure program support by stakeholders. These approvals occur at community meetings, memorandums of understanding, and permitting permissions. These approvals are valued and respected and are recognized as being unique in the current social setting. While the human dimensions science of any conservation project is no doubt complex, there are challenges and successes. Cultural considerations are critical aspects of this effort and over the 16-year history of efforts in conservation education in the area, the last four years have focused on a community need to support women and girls in STEM education and economic independence. Stories of success are testaments that this program has positively impacted the community. Stories include the program providing a safe haven for a single mother and her daughter, STEM education for local community members to oversee monitoring and science-based education, and having the first sea turtle nest of the 2022-23 nesting season be brought to the home of the project lead's house. The program staff and volunteers recognize that sea turtle conservation is not easy, but that it can be rewarding and gives many hope for future generations through incremental change, and the hard work and persistence of those involved in the program. The Nicaragua Sea Turtle and Women Empowerment Program has many testimonies of positive change and challenges to share.

*THE WAYUU VOICES: A CHANGING CONNECTION WITH THE MARINE TURTLES

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Below is a synopsis of an interview that we, the co-authors of this abstract, performed to the presenter author. My name is Jordano Palmar, here is a summary of my life which is indeed a summary of my connection with the marine turtles (*Sawäin*). I am Wayuú that was born in the Venezuelan portion of the Guajira Peninsula. Wayuús ancestral land covers Venezuelan and Colombian territories, but our ancestral land has no boundaries. I am from a fisher family (*Apaalanchi*, not Shepherds), and all my relatives are settled in multiple coastal communities along the Guajira Peninsula. Since kid, I have seen how important the marine turtles are for Wayuú People, as we used them as food, medicine, trade item, and a divine gift from *Maleiwä* (God). When I was 12 years old, my father was contacted by an *Alijuna* (non-Indigenous) student from the University of Zulia to guide him to find marine turtles in our land. Since then, I was interested in the journeys to my uncles and grandparents' houses to find turtles, because these journeys were not the common ones to find and commercialize turtles, these were to take care of these animals (which was unique at that time). After years as an accompanist of my father, I converted into the guide, translator, and protector of these journeys. I heard how my Wayuú grandparents affirmed that the turtles were more common in the past and how vital these animals are in our lives. I was invited to participate and share my experiences, as Wayuu involved in conservation, in local meetings with students and environmental NGOs. There, I also heard from these Alijunas how important are the turtles for other people in the world. Hence, we started to rescue turtles and released them after flipper tagged and named them. Since 2004, when I was 19 years old, my participation in turtle conservation took another step, I was leading the organization of Wayuú local patrols to identify stranding turtles and their rescues. I gave dozens of environmental talks in *Wayuúnaikii* (our ancestral language) in schools and to fisher communities, collected hundreds of turtle records and other megafauna species in the Guajira, and participated as a key stakeholder in national scientific events, projects, and research thesis. During the last 10 years (since 2013), Venezuela has suffered a hyperinflation crisis and economic recession that affect all conservation efforts nationally. Although this critical scenario, I kept contact with the Wayuú communities and encourage them to join efforts in the conservation of marine turtles. To date, more than 20 communities and clan leaders have been involved in the local network of turtle protectors, 343 alive turtles have been rescued and released by Wayuú fisher hands, and at least 1,711 turtles have been documented by Wayuú scientific patrols at artisanal landing sites. Nowadays, a new generation of students lead by me are surveying and reconnecting with the Wayuú communities and encouraging them to get involved in the Sawäin conservation.

HAWKSBILL TURTLE FESTIVAL AND ITS IMPACT ON CONSERVATION IN EL SALVADOR

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Festivals are events celebrated by a community that revolves around some distinctive aspect, such as religion or culture. In El Salvador, festivals are often celebrated during local or national holidays. The Hawksbill Turtle Festival is an initiative promoted by ProCosta Association since 2010 in La Pirraya community, in Jiquilisco Bay Biosphere Reserve. The aim is to thank local communities for the support provided throughout the year in the conservation of hawksbill nests and to promote awareness of the conservation of the species and the environment. The festival takes place on the last week of October to commemorate the closing of the hawksbill turtle nesting season, Before Covid 19 Pandemic the festival featured various recreational and educational activities such as a beach soccer tournament. In addition, there were drawing and costume contests, which had the requirement to be allusive to a hawksbill turtle and use only recycled materials. Through the festival, we facilitated education and community-building activities to connect multiple stakeholders, sports groups, religious groups, neighboring communities, government institutions, and non-governmental organizations. During the first nine years, we went from 4 schools involved in the festival to 6 schools nowadays, all of them from Jiquilisco Bay. As of 2020, due to the Covid 19 Pandemic, the Hawksbill Turtle Festival was reformatted to a virtual mode. Activities changed, including hawksbill conservation-themed literary, drawing, and photography contests. The virtual festival also has some advantages, such as: reaching more people through social networks, web pages, and other means, even those who are far from our coastal area and have a weaker connection to or knowledge about turtle conservation. Moreover, through this new format, the festival fosters interest in literature and arts while raising awareness among the population about the importance of conserving the species. Our expectation for future festivals is to reach more people and incorporate activities that have a more significant positive impact on the conservation of hawksbill turtles and other threatened species, vulnerable ecosystems, and respect for nature in general.

REPRESENTATION IN SEA TURTLE SCIENCE: SLOW PROGRESS TOWARDS GENDER EQUITY AND GLOBALIZATION REVEALED FROM THIRTY YEARS OF SYMPOSIUM ABSTRACTS

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Sea turtles are a circumglobally taxon that receive considerable research and conservation attention; however, there is little published information about patterns of representation for people working with these

species. To assess long-term trends in gender, geographic, and institutional representation within the sea turtle community, we quantified information from 7041 abstracts presented at the International Sea Turtle Symposium (ISTS) between 1988–2018. We report several key findings. (1) The number of authors per abstract doubled over the study period, suggesting greater acknowledgment of contributing individuals. (2) The proportion of female first and last authors has increased over time and at the end of the study period female first authors were in a slight majority (53%) even though last authors remained predominantly (64%) male. (3) Most researchers were from North America (45%) but representation from other continents has increased over time. (4) It was common for authors from North America (34%) and Europe (42%) to conducted research in other continents. This was far less common (<6%) for authors in Africa, Asia, Central America and the Caribbean, and South America. (5) Most authors (48%) were affiliated with academic institutions. Overall, our results reveal a slow trend toward gender equity and globalization in the sea turtle community. Increasing opportunities for underrepresented groups should therefore remain a key priority. To facilitate this process, we suggest hosting symposiums in underrepresented regions, providing grants for underrepresented individuals, developing opportunities to present abstracts remotely via hybrid events, and promoting gender equity in senior researcher positions.

SEA TURTLE ECOTOURISM: AN ECONOMIC ALTERNATIVE IN A RURAL LOCATION OF COSTA RICA

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Ecotourism has been employed as an effective conservation tool for numerous species worldwide. This non-extractive use of ecotourism brings benefits to species and communities, and sea turtles are the perfect example of this. Sea turtles have been exploited as the main economic resource in many coastal communities worldwide. Nowadays, the profit obtained by their non-consumptive use has been proven to be higher than the extractive use and trade of this species. Nevertheless, sea turtle ecotourism relies on several factors to be successful, such as involved stakeholders, trained guides, funding, an attractive location for tourists and a partnership with a conservation project, which is not required but usually beneficial. In the South of the Nicoya Peninsula, Costa Rica, sea turtle nesting conservation projects started in the late 90s, back then, almost every single sea turtle nest was poached. Nowadays, conservation efforts in the area have reduced this activity by at least 90%. Also, this is a rural area with a lack of job opportunities for the local people who depend on tourism. In 2011 Turtle Trax S.A (TT), a profit organization was created in the area to promote ecotourism, encouraging and supporting the protection of sea turtles, and to empower the local communities. In partnership with the Rescue Center for Endangered Marine Species (CREMA by its Spanish acronym), a Costa Rican NGO, thousands of volunteers have worked over the years alongside expert scientists in four project sites, providing job opportunities to local members of the communities. At present TT volunteer program receives between 100 to 300 volunteers a year. Only during the 2022 nesting season, TT has benefited 97 families (146 people) in the area (patrollers, cooks, cleaning service, local transportation, etc.). Of them, 138 people are benefiting directly (94.55 %) and 8 indirectly (5.7%). TT has supported more than eight local communities; San Francisco de Coyote (n=51, 34%), San Miguel (n=27, 18,4%), Corozalito (n=21, 14.3%), Costa de Oro (n=13, 8.9%), Bejuco (n=13, 8.9%), Jicaral (n=7, 4.7%), San Jorge (n=3, 2,0%) Colonia del Valle (n=3, 2,0%) and other locations (n=8, 5.4%). Moreover, the organization has been a source of revenue for local businesses (restaurants, supermarkets, cabins, etc.) during the low tourist season. In addition, the residents of the communities receive other types of benefits from the activities conducted by volunteers, such as beach clean-ups, protection of green areas, annual reforestation with native trees, awareness, and environmental education activities. Over these 12 years, one of the most remarkable successes of TT and CREMA occurred during the COVID-19 pandemic when former local employees took the initiative of monitoring nearby nesting beaches without remuneration. So far, TT is an example of how ecotourism can involve and benefit rural communities while promoting sea turtle conservation. Nevertheless, there is always room for improvement, TT next steps involve creating and integrating a solid environmental education program involving children, adults, and volunteers.

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*LOSS OF HERITAGE CULINARY TRADITIONS OF BAJA CALIFORNIA SUR – MEXICO DUE TO THE ENDANGERED EXTINCTION OF SEA TURTLES

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The cultural food identity of the people is currently dissipating, since even in remote communities, the global market has been gaining ground. If we add to this the loss of natural resources due to overexploitation, as is the case of the sea turtle, with this, the eating habits in many communities have changed. The present research analyzes the importance of the sea turtle in the gastronomic culture of Baja California Sur since its early days, the various forms of preparation, beliefs and traditions around its consumption, the typical recipes of the region are also listed. The methodology consisted of a bibliographical review regarding the subject, the theory of the disciplines of the social sciences and the area of study. Field work was also carried out during which communities related to sea turtles were visited, in which interviews were conducted, using the life history technique. An intentional capture was carried out to find the informants with specific knowledge, in this case of fishing or conservation of sea turtles. To contact the interviewees, a snowball demonstration was carried out, in which key informants were contacted and asked to name other possible contacts for the investigation. The Worster and Cariño models were used to carry out the analysis. The latter was used to carry out the diachronic analysis and that of Worster for the synchronic analysis. The results of this research show that the first humans in Baja California Sur took advantage of what the desert sea offered them for their livelihood, among the variety of elements were sea turtles, which ended up occupying a special place in the table of the South Californians, since its use prevailed among the indigenous people, the European occupation, becoming a traditional use, one of the identity symbols and one of the hallmarks of the region. Due to the situation of danger of extinction of sea turtles, not only is there a risk of losing an important element with ecological interconnections, but also important traditions and the identity of some regions are being lost, such is the case of Baja California Sur, which lost the use of its typical food and with it, also lost part of its culinary identity, when the ban was decreed and the consumption of sea turtles was prohibited. The above evidences the profound interdependence that exists between intangible cultural heritage and material cultural and natural heritage. Gastronomy is a repository of local knowledge highly appreciated by cultural relativism. In this sense, in addition to protecting natural resources, the need to make records, inventories, catalogs and research of traditions, techniques, products and food ingredients in our country is very important, since they condense and can represent various values: economic, symbolic, medicinal, among others. The gastronomic culture also has a functional and social value that can even encourage local economies, contribute to the sense of belonging and appreciation of the territory as well as encourage the protection of natural resources on which it depends.

*A SOCIO-ECOLOGICAL CHARACTERIZATION OF HOUSEHOLDS THAT ENGAGE IN HAWKSBILL EGG COLLECTION ON THE PACIFIC COAST OF EL SALVADOR AND NICARAGUA

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A prevailing belief among sea turtle conservationists working in low-income countries is that poverty increases the propensity to engage in the illegal extractive use of turtles. This logic has influenced numerous conservation interventions that seek to reduce illegal extraction by improving the livelihoods of egg collectors or turtle hunters. In this study, based on the Sustainable Livelihood Framework, we investigate differences among egg-collecting and non-egg collecting households; namely, how they differ in their social-ecological characteristics and perceptions of sea turtle egg collection. During 2016 and 2017, we collected social-ecological data in 13 communities near three of the most important nesting rookeries of the eastern Pacific hawksbill (*Eretmochelys imbricata*) in El Salvador and Nicaragua. We conducted a census identifying 1281 households and a more in-depth deeper socio-economic survey with a randomly selected sample of 380 households. We asked egg- and non-egg collecting households about their motivations for engaging in or avoiding egg collection. Additionally, we analyzed the association between household engagement in egg collection and socio-ecological indicators. We found that 27% of households collected sea turtle eggs at least once during the12 months prior to the interview. Egg collection was mainly motivated by income; however, other socio-ecological factors might mediate which households depend on this activity for subsistence. Households that did not engage in egg collection perceived egg collection as not economically worth the difficulty of the task, but rarely expressed pro-conservation motivations to explain their behaviors. We found evidence that egg collection contributes to egg collecting households' food security. Also, households that reported collecting turtle eggs tended to diversify their livelihood portfolio and engage in other extractive practices as well. Our results suggest that, within the range of socio-economic conditions observed in the study sites, participation in egg collection is independent of poverty, but dependence on egg collection correlates with some socio-economic characteristics, mainly in the human capital dimension (i.e., schooling, access to wage jobs) and demographics such as gender and age. Here, we discuss the implications of these findings, underscoring that egg collection as a livelihood strategy might not be meaningfully reduced only through changes to the livelihood assets of egg collecting households.

CONSERVATION TOURISM PROGRAM IN BAHÍA DE JIQUILISCO, EL SALVADOR: CHALLENGES AFTER THE COVID-19 PANDEMIC

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In El Salvador, the Pacific Ocean floods a sea inlet off the coast of Usulután, known as Bahía de Jiquilisco, and centuries ago the indigenous people called it "Xiriualtique," or "place in the bay of the stars." The lights are confused in the water, and some residents assure that the peaceful waters become the mirror of the sky. In the Xiriualtique – Jiquilisco Biosphere Reserve, two fundamental processes are preserved contributing to the conservation of landscapes and ecosystems. The first is the presence of the most significant extension of mangroves in El Salvador. This ecosystem is also a priority worldwide because they represent 46.82% of the mangroves of the north coast of Mesoamerica, an ecoregion whose status has been declared Critical/Endangered. These ecosystems provide environmental services and are the basis of the livelihoods of most of the neighboring communities. The Bay of Jiquilisco has many beaches used by four species of sea turtles to nest. In its mangrove system, adult and juvenile individuals have also been observed carrying out foraging activities. ProCosta has developed the Conservation Tourism Program, which provides alternative sources of income for community members by increasing visits and providing lodging and food to tourists and travel representatives. Some of the benefits that this program has brought to local communities are English lessons to guides and students and beach cleaning campaigns, benefiting around 22 families. Participation in the Conservation Tourism Program allows ProCosta to obtain information about sea turtles, and since the activities involve local people in sustainable practices allowing them to earn income while helping conservation, it is the participation of volunteers and tourists in this program that becomes very important. The Covid-19 pandemic in 2020 brought many challenges for this program by drastically reducing the visits of tourists and volunteers to Jiquilisco Bay (receiving 260 tourists, spread over twenty-five tours on 2019), starting almost from scratch the years after today, which makes it important to propose new strategies to continue benefiting local families.

*PEOPLE, TECHNOLOGY, AND INNOVATION: A SOCIO-ECOLOGICAL FRAMEWORK TO UNDERSTAND INDIVIDUAL AND COMMUNITY-LEVEL RESPONSES TOWARDS BYCATCH REDUCTION SOLUTIONS

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Fishing is an integral component of people's cultural identity, food supply, and economic security worldwide. However, intense fishing efforts can disrupt oceanic health from overfishing and bycatch. In particular, fisheries bycatch, or the incidental capture of non-target fisheries species, has been a contributing factor to the decline of several sea turtle populations worldwide. To help better understand the relationship between bycatch reduction initiatives, fishers, and fishing communities, my dissertation research uses a socio-ecological approach to explore individual and community-level responses to the bycatch problem and corresponding bycatch solutions. To directly reduce sea turtle bycatch, we are partnering with artisanal fishers in the Gulf of California and the Pacific coast of Mexico to conduct various experimental trials on gillnet gear modifications and collecting fisheries data to evaluate the effectiveness of fishing with modified versus traditional gear. To encourage the adoption of these innovations for global use, we will then conduct interviews along the Baja California Peninsula, Mexico using a mixed-methods approach to assess fisher's willingness to participate in experimental gear trials and uncover factors promoting and hindering the adoption of bycatch reduction modifications. We will recruit fishers who have in the past, currently express interest, as well as fishers who have declined to participate in experimental trials of modified fishing nets to reduce bycatch. Interview responses will allow informed evaluations on the potential benefits and limitations fishers may face when thinking about and fully adopting any bycatch reduction gear.

Preliminary results for this work are expected by the end of 2023. To determine community-level responses towards bycatch reduction solutions, we will investigate to what extent the composition of fishing communities can influence perceptions of bycatch, including perceptions of using bycatch reduction fishing gear, via historical experiences, online databases, and previously collected survey data across the Baja California Peninsula and the mainland of Mexico. Our goal is to pinpoint aspects of fishing communities, such as demographics, location, and prior level of conservation engagement, that can be predictors of bycatch knowledge and receptiveness towards bycatch reduction solutions. An on-going international project, MarEs Comunidad, will serve as a study system for this framework. This work will shed light on the importance of involving fishers and fishing community perspectives into long-term solutions for bycatch reduction.

EXPLORING IMPACTS OF SEA TURTLE CONSERVATION EFFORTS ON RESOURCE USERS IN SÃO TOMÉ ISLAND, WEST AFRICA

Sara Alexandra Vieira[1,2], Betânia Ferreira-Airaud[1,2], Victor Jiménez-Guri[1], Manjula Tiwari[3], and Ana Nuno[4,5]

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[4]*Centre for Ecology and Conservation, College of Life and Environmental Sciences, University of Exeter, Penryn, Cornwall, TR10 9FE, UK*
[5]*Interdisciplinary Centre of Social Sciences (CICS.NOVA), School of Social Sciences and Humanities (NOVA FCSH), NOVA University Lisbon, Avenida de Berna, 26-C, 1069-061 Lisboa, Portugal*

Worldwide conservation initiatives have attempted to improve the conservation status of sea turtles since the 1950s. Despite these efforts, sea turtle harvesting for human consumption is still considered a main treat in many regions of the world, partly due to lack of compliance with conservation regulations. Meanwhile, research suggests that conservation efforts - which also take socio-economic factors, such as turtle trade as the main livelihoods into account during planning and implementation- are more likely to succeed. São Tomé and Príncipe archipelago harbours important breeding and feeding grounds for five of the seven threatened species of sea turtles that exists nowadays in the world. Sea turtles have been traditionally exploited for commercial, cultural and subsistence reasons and until recently its exploitation and trade represented a significant source of income for local communities. This study examined the compliance and socio-economic situation of the main actors of sea turtle trade at São Tomé, where a national law decree protecting sea turtles was adopted in 2014, criminalizing its possession, trade and transportation. Market research with the key actors of turtle trade was used to collect qualitative and quantitative data on temporal and spatial trade in 2014, before the approval of the legal protection framework. A second inquiry was conducted in 2022 to former and actual turtle traders, focus on how their economic circumstances had been affected, their opinion on conservation efforts and how the trade had change. We found that the impacts of marine conservation on their economic situation affects their attitude towards and compliance with conservation efforts. The results of this study indicate the importance of considering socio-economic factors and of involving local communities when planning and implementing conservation efforts, to ensure sustainable conservation and management of sea turtles and other threatened marine species.

INDEX I: SESSION DESCRIPTIONS

ANATOMY, PHYSIOLOGY AND HEALTH

Session Chairs: Roldan Valverde, Amanda Williard, Daphne Wrobel, and Jeanette Wyneken

This session includes research on all aspects of sea turtle form and function, as well as the causes and consequences of individual and population-wide health problems and how these relate to the environment. Relevant topics include studies and reports on anatomy, physiology, reproductive biology, thermoregulation, osmoregulation, functional morphology, diseases, veterinary care, rehabilitation, epibionts, parasites, health assessment, embryology, and pathology.

CONSERVATION, MANAGEMENT AND POLICY

Session Chairs: Matthew Godfrey, Shaleyla Kelez, Brad Nahil, and Aliki Panagopoulou

This session will highlight work on economic, legal, policy, and management aspects of sea turtles and their conservation. Topics include studies and reports that address issues of legislative support and enforcement, policies and programs that safeguard sea turtles and their habitats, management issues related to sea turtle monitoring and conservation, and related matters. This session will also include reports on the implementation, results, and impact of initiatives and international agreements pertaining to sea turtle protection.

EDUCATION, OUTREACH AND ADVOCACY

Session Chairs: Mustapha Aksissou, Aminta Jauregui, Zoe Meletis, and Rebecca Mott

Sea turtles cannot be protected or conserved unless people take an interest in their continued survival. This session focuses on innovative educational methods for raising awareness of sea turtles and promoting their conservation in different parts of the world, as well as efforts to develop and enhance advocacy efforts on behalf of sea turtles at any level of community or government. Topics include a broad range of approaches to educational outreach and to advocacy, as well as strategies for influencing decision-makers and efforts to convert potential adversaries (e.g., fishermen or egg poachers) into allies.

FISHERIES AND THREATS

Session Chairs: Jeffrey Mangel, Mariela Pajuelo, Jesse Senko, and Yonat Swimmer

This session focuses on the evaluation of natural and anthropogenic threats that degrade the condition of critical sea turtle habitats, or which increase the risk of mortality and major population declines of sea turtles on any geographic scale. Topics include fisheries bycatch, characterization of fishing gear and fishing effort, directed take, strandings due to any factor (including cold-stunning), impact of degradation of nesting and feeding habitats, impacts of urban development in coastal areas, and emerging threats from climate change, among others. Presentations may also include evaluation of potential impacts of either known or newly discovered threats, as well as proposed or actual measures taken to reduce risks to turtle populations.

IN-WATER BIOLOGY (BEHAVIOR, ECOLOGY, MIGRATION, TELEMETRY, FORAGING)

Session Chairs: Kara Dodge, Alexander Gaos, Katharine Hart, Summer Martin, and Gabriela Vélez-Rubio

After entering the ocean as hatchlings, sea turtles do not leave the sea again except to nest (or occasionally to bask). This session broadly encompasses the biology of sea turtles in the ocean. It includes research on turtles of all life-history stages, with the goal of better understanding the biology and ecology of turtles in their underwater habitats. Suitable topics include behavioral or observational studies related to migration, diving, foraging, or navigation, as well as sightings, surveys and monitoring of turtles at sea (e.g., in developmental habitats or foraging areas), conservation status evaluations, and the structure and dynamics of populations, subpopulations, and metapopulations. Other topics include telemetry and movements, patterns of resource use and residency, mating behavior and social interactions, feeding behavior and diet composition, the ecological role turtles play in their diverse habitats, and the implications of habitat condition on the health and sustainability of turtles.

NESTING BIOLOGY (ECOLOGY, BEHAVIOR, AND REPRODUCTIVE SUCCESS)

Session Chairs: Ray Carthy, Adriana Cortés-Gómez, Mariana Fuentes, and Catherine Hart

This session will focus on nesting beaches, nesting females, nests, hatchlings, eggs, and closely related topics. Relevant subjects include assessments of nesting population size, modeling of population parameters, long-term monitoring of nesting trends, forecasting population change, behavior of turtles on nesting beaches, hatching/emergence success and hatchling production, sea-finding behavior, environmental impacts on egg viability or nesting, newly discovered or newly colonized nesting areas, and related topics. Reports of nesting activity for short-term periods (<10 years) may be included in the poster session; studies revealing long-term nesting trends may be suitable for oral presentation if they reveal lessons relevant to other geographic areas.

POPULATION BIOLOGY AND MONITORING (STATUS, MODELING, DEMOGRAPHY, GENETICS, NESTING TRENDS, IN-WATER TRENDS)

Session Chairs: Alberto Abreu-Grobois, Rocío Álvarez-Varas, Pilar Santidrián Tomillo, and Ximena Vélez-Zuazo

This session focuses on sea turtle population assessments and related topics. Specific topics include population demography (i.e. survival probabilities, growth rates and reproductive rates); abundance and trends; population structure and population connectivity; population genetics (e.g., mixed stock analysis); management unit/population segment definitions. Studies from both nesting and foraging habitats are welcomed, as are modeling approaches to population biology in which mathematical or simulation models are used to elucidate marine turtle population parameters and vital rates.

SOCIAL, ECONOMIC ANS CULTURAL STUDIES

Session Chairs: Karla Barrientos-Muñoz, Héctor Barrios-Garrido, Seh Ling Long, and Andrea Phillott

Sea turtles play a crucial role not only in marine ecosystems, but also in human societies. This session includes presentations that broadly explore the human dimension of sea turtles and the importance of turtles in diverse cultures and societies around the world. Some presentations focus on research projects, but others highlight initiatives related to the conservation of sea turtles and their habitats, or efforts to understand local attitudes toward sea turtles and conservation. Topics include but are not limited to: social science and/or anthropological research; discussions of cultural considerations related to conservation and management; sea turtles in local folklore, mythology, and culture; examinations of conflict and conflict resolution; studies of information and/or technology transfer between local peoples and other experts.

WILDLIFE CRIME: ILLEGAL TRADE IN MARINE TURTLES

Moderator: Christine Hof
Panelists: Héctor Barrios-Garrido, Brad Nahill, Nicholas Pilcher, and Jesse Senko

This session investigates issues and limitations currently hampering the fight against the illegal trade in marine turtles. From differences in scale (i.e., local, regional, and/or global) to socioeconomic values to legislation and enforcement, the panelists will discuss combining participatory research and conservation approaches to reduce this illegal trade.

HOW CAN TECHNOLOGY IMPROVE CURRENT CONSERVATION EFFORTS?

Moderator: Jeffrey Seminoff
Panelists: Andrews Agyekumhene, Claire Jean, Lourdes Martínez-Estévez, and Bárbara Sellés-Ríos

Technology has played a key role in research and conservation of sea turtles for the last several decades. From cellphones to satellite tracking, from drones to net illumination, the advancement of technology has allowed scientists to find better ways to monitor, study, and protect sea turtles in their natural environment. In this 1-hour Panel discussion, we host experts from a variety of disciplines to discuss the value of novel and well-established technologies and explore how these approaches can be used to their full potential for advancing sea turtle conservation in coastal communities worldwide.

THE ULTIMATE GOAL OF HATCHERIES: A BALANCE BETWEEN BUSINESS AND CONSERVATION

Moderator: Nicholas Pilcher
Panelists: Diego Amorocho, Gustavo Lara, Eblin Pérez Castillo, and Jeanette Wyneken

Many sea turtle conservation projects across the globe include hatcheries in their repertoire of ‘eco-friendly’ activities. In many cases these are well-justified, in others it is often hard to find the conservation advantages. Rather, these practices are linked to ‘visible solutions’ and ‘business strategies’ with more apparent benefit to the implementor than for the turtles. This session will explore some of the early life stage biology of sea turtles, highlight the importance of these in the design of conservation (and even tourism appreciation) strategies, and identify some of the “best practices” that could be applied to achieve a balance between ecotourism and conservation.

COMMUNITY-BASED CONSERVATION OF MARINE TURTLES: THE NEXT GENERATION

Moderator: Adriana Cortés-Gómez
Panelists: Alexandre Girard, Neca Marcovaldi, Ruth Nibeth Martínez, and Jordano Palmar González

Community empowerment can deliver better marine turtle conservation outcomes. This session explores ways to rapidly scale up our conservation strategies designed to build stronger and deeper alliances with the native and local communities with whom we have the privilege to work. We will have the pleasure to listen to stories directly from leaders of the communities dedicated to the conservation of marine turtles, as well as established researchers and educators that have worked hand-by-hand with coastal communities.

INDEX II: SPECIAL SESSION DESCRIPTIONS

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Panelists: Héctor Barrios-Garrido, Brad Nahill, Nicholas Pilcher, and Jesse Senko

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INDEX III: WORKSHOP DESCRIPTIONS

WORKSHOP 1: A STRATEGY FRAMEWORK ON THE DEVELOPMENT OF SOLUTIONS TO ADDRESS THE KEY THREAT OF SEA TURTLE TRAFFICKING AND DIRECT TAKE IN THE CARIBBEAN, CENTRAL AND SOUTH AMERICA

Organiser: Ann Marie Lauritsen

Objective: A strategy framework on the development of solutions to address the key threat of sea turtle trafficking and direct take in the Caribbean, Central and South America with the incorporation of institutional capacity building, behavioral change and community-based conservation approaches.

In collaboration with the Inter-American Convention for Protection and Conservation of Sea Turtles (IAC), the U.S. Fish and Wildlife Service are hosting a one-day workshop to develop a strategy framework of solutions to address sea turtle trafficking and direct take in the Caribbean, Central and South America.

The workshop will be comprised of three components:

- Success stories in combatting sea turtle trafficking. The session will include presentations of examples from the field (case files) for combatting wildlife trafficking (CWT) of sea turtles in the Caribbean, South and Central America.
- Roundtable Discussion. This roundtable will discuss efforts to address direct take and wildlife trafficking in the Region.
- Special Session: Behavioral Change Interventions in Practice for Conservation. IAC will organize this session which will be designed and delivered by RARE- Center for Behavior and Environment.

The session will provide a basic understanding of the principles of behavioral science with which to design environmental solutions. In this session participants will work on applying the tools of behavior-centered design to promote protection and conservation of sea turtles. The content will be geared towards those actively working on the issue of trafficking and direct use of sea turtles in Central and South America in an effort to provide knowledge and tools necessary for practitioners and agencies to adopt this behavioral change approach in their programs.

WORKSHOP 2: DRONES AND SEA TURTLES

Organisers: Alan Rees, Ray Carthy, Thane Wibbels, Nerine Constant, and Natalia Teryda

The four-hour session is intended to bring together sea turtle researchers that are experienced, novice, and just interested in using UAVs or drones. The primary aims are to continue dialogue on the best use of UAVs for sea turtle studies and catalyse a network where technical advances and method development are shared. The session would be divided into two interactive parts, where the attendees are encouraged to ask questions to the presenters and the group at large.

1. Brief introduction to UAVs and technology a. Types of UAV, their general properties b. Data capture and processing options c. Review of current level of relevant peer-reviewed literature.

2. Examples of UAV use a. General outline of basic research topics b. (hopefully) Brief demonstrations on some of the popular software used to control UAVs and process data c. Brief presentations of UAV research undertaken by workshop participants.

The workshop is envisaged to be repeated and developed over successive years/symposia so that the international sea turtle community are kept up-to-date with advances in UAV-based research and ‘recruits’ to the field have the opportunity to learn from experienced practitioners firsthand.

WORKSHOP 3: SEA TURTLE MEDICINE AND REHABILITATION

Organiser: Daniella Freggi

The proposal of this workshop emerges from the evidence of the numerous sea turtle rescue centres developed in the last decade, sometimes facing emergencies with no available support of expertise. The lack of information may cause a waste of energy and economical resources, uncertain results, and more important: pain for animals.

This workshop is addressed to people directly involved in sea turtle rehabilitation and care, offering the opportunity to share rehab and medical skills, knowledge, experiences and standard operating procedures. We propose to compare expertise on diagnostics, husbandry, critical care, lesions, anaesthesia and surgery, with the aim to develop an open discussion among participants.

We hope to better update the role of sea turtle rescue centres in the conservation efforts, a functional network among them and their future perspectives. We hope the realization of a common agreement that may support the standardization of common protocols and medical administration, with a particular attention to high quality procedures for the care and convalescence of sea turtles. Everyone is invited to be an integral part of the debate.

WORKSHOP 4: REDUCING BYCATCH BY BUILDING CAPACITY FOR COLLABORATIVE RESEARCH AMONG FISHERS AND CONSERVATIONISTS

Organisers: Michel Anthony Nalovic and Juan Manuel Rguez-Baron

Injurious interactions between fishing activities and marine turtles is a theme that concerns conservation (and fisher) communities around the world. As such, ISTS continues to promote the idea that fostering change amongst fishers regarding bycatch and its causal factors is a critical component in achieving sustainable development. Special sessions that address the challenges and best practices of developing working relationships with fishers to address bycatch were held during ISTS New Orleans, USA (2014) and ISTS Lima, Peru (2016). During these sessions, specific attention was given to bycatch issues of immediate importance to the host region (TEDs in US shrimp fisheries; bycatch reduction in Peruvian artisan gillnet fisheries).

Seeing that this year's ISTS annual meeting is in Cartagena, we want to seize the opportunity to host a bycatch session that will bring together fishers and scientists working on bycatch with Caribbean conservationists seeking a deeper understanding of how to reduce bycatch in their local communities. We will encourage all participants, and especially those working in Colombia, to invite fishers who are open to sharing their experience with bycatch and working with scientists/conservationists. During the session we will identify the challenges faced by stakeholders and update participants on recent developments in bycatch knowledge and technologies, both developed in the Wider Caribbean and elsewhere in the world. Case studies with very practical results will be featured; e.g., how bycatch issues were identified/quantified/prioritized, how responses were developed/implemented/ evaluated, and what tools can be shared in order to replicate success elsewhere. We will explore bycatch mitigation techniques (gear and human dimensions) that are most likely to be successful in the Wider Caribbean region. Finally, the highlight of this session will be a panel composed of fishers who will present their ideas as to how scientists/conservationists could better approach fishers to get things moving in the right direction.

The overarching goal of the workshop is to give participants a deeper understanding on how we can better foster voluntary behavior changes by fishers in favor of saving turtles, and how conservationists can most effectively support the process.

WORKSHOP 5: DESIGNING BEHAVIOR CHANGE CAMPAIGNS FOR SEA TURTLE CONSERVATION

Organisers: Roderic Mast, Rachel Smith, Brian Hutchinson, and Ashleigh Bandimere

Team BEACH (BE A CHangemaker) is an initiative started by the State of the World's Sea Turtles (SWOT) Program at Oceanic Society and Disney Conservation with the support of AZA-SAFE that aims to encourage human behavior change campaigns and education programs that will result in successful conservation of sea turtles and their habitats. Since its creation in 2018, Team Beach has built a network of projects from around the world that have worked together, shared ideas and resources, and hosted several educational webinars. While many sea turtle conservation organizations implement outreach programs in their communities, not all of them are designed with tangible behavior change goals and evaluation plans. The goal of Team BEACH is to create a network of sea turtle conservationists and behavior change experts who can share case studies, best practices, instructional materials, and stories so that outreach efforts drive behavior change for sea turtle conservation. Prior to ISTS, we will request that members of the Team BEACH network submit real-world conservation issues in their communities that they feel could be addressed through a targeted behavior change campaign. After an introductory presentation in which we discuss how to create a successful outreach campaign and associated evaluation, we will ask workshop participants to form small groups and brainstorm effective behavior change programs for each of the case studies. We will then ask them to present these solutions back to the larger group and facilitate open discussions about each solution with the group. By the end of the workshop, participants will have learned about tools from behavior change specialists and will have applied those tools to real-life scenarios that sea turtle conservation professionals are facing. They may even create strategies that could be developed and implemented by Team BEACH members.

WORKSHOP 6: THE CLIMATE-THREATS MATRIX: UNDERSTANDING AND QUANTIFYING THE INTERACTIONS OF CUMULATIVE STRESSORS WITH CLIMATE CHANGE AND THE RESULTING IMPACTS ON SEA TURTLES

Organiser: Matthew Lettrich

Climate change exposure is multi-faceted (changes in sea and air temperatures, sea level rise, and ocean acidification, among others) and is realized across a spectrum of spatial and temporal scales. The direct effects of climate change on sea turtles have drawn the focus of recent research and represent a growing area of study. The effects of non-climate threats on sea turtles have received much attention historically, though coverage has been patchy across regions and species, and new threats continue to emerge. The effect of climate change on other stressors, and the downstream/cascading effect on sea turtles has received considerably less attention but will be an important component of conservation planning in a rapidly changing world.

Understanding how direct and indirect stressors that impact sea turtles may change at different spatial and temporal scales will be necessary to craft effective conservation strategies and will be an integral piece of the management response to climate change.

This workshop builds on the momentum and success from 2022's "Understanding and quantifying cumulative and synergetic stressors to sea turtles" workshop and focuses on the cascading effects of climate change on other sea turtle stressors. The workshop will include introductory presentations related to climate change and sea turtle threats followed by interactive breakout sessions that use participatory assessment approaches in which the participants will use their own expertise to explore and characterize the interactions between climate change and the threats identified in the 2022 workshop.

WORKSHOP 7: APPLICATIONS OF SEA TURTLE REFERENCE GENOMES FOR RESEARCH AND CONSERVATION MANAGEMENT

Organisers: Blair Bentley, Camila Mazzoni, and Lisa Komoroske

Recent advances in sequencing technologies have facilitated the assembly and annotation of high-quality reference genomes for a number of sea turtle species. While reference genomes provide invaluable resources for studies into sea turtle conservation, ecology, morphology, and physiology (among others), their use uptake is hindered by gaps in understanding of how to effectively apply them. In this workshop, we will briefly introduce the process of genome assembly, followed by a primary focus on demonstrations of how they can be used to answer research questions in the context of sea turtles. The workshop will include presentations from participants that are currently utilizing reference genomes in their research, as well as presentations outlining more specific technical aspects of their use.

WORKSHOP 8: STUDENT COMMITTEE WORKSHOP: CAREER PATHS AND KEY APPROACHES TO PREPARE AND SUCCEED IN THE SEA TURTLE WORLD

Organisers: Renato Saragoça Bruno, Matthew Ramirez, and Gabriela Arango

Each year, the student committee develops a Workshop presenting information on how to find jobs or funding, current available jobs, and other career advice. We will have guest speakers from a variety of fields who are qualified to offer advice on these subjects. We will also discuss the key skills that you need at each of those jobs and resources to begin preparing for them. More specifically, this workshop will focus on the wide breadth of sea turtle-related career paths and advice for students and new graduates to succeed in each one. This will range from governmental jobs, academia, nonprofit and for-profit careers.

WORKSHOP 9: MALE SEA TURTLES: CURRENT GLOBAL CONSERVATION AND RESEARCH EFFORTS

Organisers: ProOcean Marine Research Conservation and Innovation and Archie Carr Center for Sea Turtle Research

Much of what we know about the ecology and biology of sea turtles is based on nesting females, and to a lesser extent on juveniles in foraging and developmental habitats. These studies have sought mainly to understand natal homing, nest site fidelity, migratory movements, nesting trends, somatic growth rates, survival rates, and population structure. Comparatively little effort has been invested in understanding male sea turtle ecology, and even less has focused on the management and conservation of male turtles. Unlike females, males only rarely come ashore and the difficulties posed by capturing males at sea have made locating their feeding, courtship, and mating areas a challenge. Studying male sea turtles in foraging and mating areas across the globe is vital to better understand male habits, reproductive strategies, operational sex ratios, population dynamics, and habitat needs. After the successful workshop held in Charleston in 2019 focused on male sea turtles, where more than 60 researchers from around the world participated, now is the time to continue promoting interest in including male sea turtles in research and conservation efforts. Therefore, we propose to meet in a workshop to learn about current research and conservation efforts and how we can establish collaborations and synergies to make these efforts effective.

WORKSHOP 10: 4TH WORKSHOP ON PLASTIC POLLUTION AND SEA TURTLES

Organisers: Daniel González-Paredes, Alejandro Fallabrino, Andrés Estrades, Mark Hamann, Brendan Godley, and Emily Duncan

Plastic pollution represents an emerging threat to marine turtles, affecting vital processes across their life cycle and key habitats. Understanding the impacts caused by plastic pollution on marine turtles is central for assessing their vulnerability to this threat. The main objectives for the 4th Workshop on Marine Debris and Sea Turtles are:

1. Assess the current background and identify gaps in research and conservation efforts addressing the plastic pollution issue.
2. Discuss standard procedures and reporting metrics for broader and comparable studies.
3. Provide guidelines for assessing plastic pollution impacts according to resource accessibility.
4. Propose a common framework for the evaluation of plastic pollution threat at regional and global scales.

This event is designed as a dynamic meeting where experts and attendees will analyze and discuss, through discussion groups, topics regarding plastic pollution. The event is aimed at any scientists, researchers or/and organizations who are interested in the subject of plastic pollution and its effects on marine turtles (no previous background needed).

WORKSHOP 11: FUTURE TECHNOLOGIES FOR LARGE-SCALE MONITORING OF MARINE TURTLE NESTING POPULATIONS

Organisers: Liliana Poggio Colman and Ana Rita Patricio

Major nesting colonies (e.g. those with >10000 nests per year) play a pivotal role in driving marine turtle population dynamics and are often used as indicator sites for assessing the regional and global conservation status of these species. However, high densities of nesting females and/or large geographic areas mean that such populations are often logistically difficult to monitor using conventional nest counts or mark-recapture. Given that monitoring often competes for limited resources with management activities that contribute to species recovery, efficient approaches for estimating nester abundance and trends at these sites are urgently needed.

This workshop aims to bring together expertise to reflect on the specific challenges associated with monitoring large marine turtle nesting aggregations and discuss how emerging, labour-saving technologies could help (or not) to address them. The intended audience are managers and researchers involved in the monitoring of nesting populations where traditional nest counting or mark-recapture is proving to be difficult, or in places where population growth will likely render current monitoring approaches impractical in future.

Using selected case studies, speakers working on large nesting populations will first set the scene by outlining current monitoring solutions and challenges. Participants will then be invited to share experiences of using technology to monitor marine turtle nesting numbers in the field (e.g. drones, remote sensing, thermal imaging cameras) and reflect on the cost, scalability and reliability of these approaches compared to more conventional methods. Finally, we will consider what technologies might be around the corner that could transform the way in which large marine turtle populations are monitored in the near future.

WORKSHOP 12: STRENGTHENING COMMUNITY-BASED ENVIRONMENTAL EDUCATION THROUGH EFFICIENT USE OF TECHNOLOGICAL COMMUNICATION TOOLS

Organisers: Amalia María Cano-Castaño, Anjelika Solé Abdo Abou Issa, Antonio Trujillo, Diana del Pilar Ramírez, and Georgina Zamora

Environmental Education (EE) is one of the most powerful tools in the conservationist's toolbox, although it is regularly misunderstood and undervalued. It is essential to clarify and strengthen the understanding and reach of EE – a widely used concept since the world's first Intergovernmental Conference on Environmental Education, in 1977, organized by UNESCO/UNEP in Tblisi, Georgia (USSR). In specifically promoting community development –at all levels– as well as the efficient employment of all appropriate technologies, EE is directly relevant to all sectors of society, from marginalized producers to elite consumers and corporate exploitative activities. Countries such as Brazil and Colombia have incorporated EE into national and state legislation, including marine turtle protection programs.

Regularly turtle conservation programs, integrated with EE activities, are carried out with very limited resources, in challenging conditions for communication; hence, it is essential that EE practitioners make the fullest, most efficient use of available technologies to facilitate and enhance communications, from local to international levels.

This workshop, with a maximum or 40 participants, will strengthen the understanding and reach of EE, through discussion, familiarization, and practice of common communication technologies. Furthermore, the workshop promotes the realization that "technology" can include the most recent digital apparatus to Pleistocene stone axes, any of which can be relevant to conservation of marine turtles and their habitat.

INDEX IV: VIDEO PRESENTATION DESCRIPTIONS

IT'S TURTLE TIME!

Carol McCoy, *Coastal Wildlife Club, Inc.*
Country: United States of America

A simple and fun video for use on social media to open turtle season and to remind tourists and locals alike of the basics... lights out, fill holes, pick up trash, remove obstacles from the nesting beach. Had thousands of views and performed well on social media. We received requests for "the turtle" to visit at schools to read to children and to attend community and school events. The source video was used to create 3 short tiktoks and 3 IG reels as well as this longer version.
https://vimeo.com/782108594/45b16819a9?embedded=true&source=vimeo_logo&owner=179122731

A TALE OF TWO SPECIES

George Shillinger, *Upwell*
Country: United States of America

A comparison of the conservation stories of harbor porpoises and Pacific leatherback sea turtles off the coast of California. Learn more about the challenges and successes in protecting California's marine environment.
https://www.youtube.com/watch?v=ssu6HZ-wQFo

BUILD A BETTER BOX FOR SEA TURTLES

Katherine Comer Santos, *The Science Exchange Internship Program*
Country: México

In 2020, the Science Exchange non-profit, in partnership with the Sea of Change Foundation, held a design contest called “Build a Better Box for Sea Turtles” to replace commonly-used polystyrene egg incubators with a more environmentally friendly alternative. We received contest entries from around the world and expert judges chose 5 to be built and tested against the polystyrene control. Prototypes were filled with sand only and temperatures were monitored for 45 days. The design contest winner is revealed in this video. Round 2 field testing results include moisture monitoring and can be found in the Nesting Biology poster section.
https://youtu.be/RuuWFlyoDJ8

THE DANGEROUS LIFE OF A LEATHERBACK

Soraya Wijntuin, *WWF-Guianas*
Country: Suriname

This is about the leatherback turtle and their dangerous journey from the Caribbean to Canada. When a leatherback hatchling in the Caribbean crawls out of its egg it faces a life full of dangers. Most of these are caused by humans such as pollution, unsustainable fishing activities and poaching. No wonder leatherbacks of the North West Atlantic population are endangered. This amazing species is part of our history, our culture and an important for ecotourism. Imagine we don’t act and loose this amazing species forever; this would mean that we would lose a part of ourselves as a region.
https://youtu.be/xjyWycDWc3M

LEATHERBACK TURTLES: A REGIONAL ACTION PLAN FOR THE NWA LEATHERBACK POPULATION

Soraya Wijntuin, *WWF-Guianas*
Country: Suriname

The leatherback turtle population in the Northwest Atlantic is showing a worrying decline and the IUCN Red List status was updated to "endangered" in 2019. That is why a threat investigation has been carried out to determine the cause of the decline. Based on these threats, a regional action plan has been developed with concrete actions that must be implemented to give the NWA Leatherback population a chance to recover. In this short documentary, various stakeholders and those who contributed to the action plan, explain the importance of this unique species for our waters and our society.
https://youtu.be/1zI-l77lBGw

FRENCH GUIANA SEA TURTLE CARTOON SPOT

Mathilde Lasfargue, *French Biodiversity Agency (Office Français de la Biodiversité)*
Country: French Guiana

The Sea Turtles Network Of French Guiana takes you to discover the life of a leatherback turtle. From its hatch to its return on the same beach many years later, danger is lurking! Admiring it laying its eggs is a rare opportunity needing our utmost care. This spot is funded by the European Union.
https://youtu.be/0JxZnb2PVio

FRENCH GUIANA SEA TURTLES NETWORK - A VISION ABOUT SEA TURTLES: MEETING KWATA

Mathilde Lasfargue, *French Biodiversity Agency (Office Français de la Biodiversité)*
Country: French Guiana

Welcome to the new web-series produced by the French Guiana Marine Turtle Network! Through this series of short portraits (3 to 5 minutes), we invite you to discover the diversity of actors who participate in the conservation of marine turtles in Guiana within the network. In this first episode, let's meet Françoise, a committed and moving volunteer for the Kwata ONG (www.kwata.net), widely involved in marine turtles conservation campaign.
https://youtu.be/RExaAF2TixQ

LA CAMINATA

David Godfrey and Georgina Zamora Quílez, *Sea Turtle Conservancy*
Country: Costa Rica

Every Saturday Ivan wakes up at 4am to walk 29.4km in the beach. His work for the Sea Turtle Conservancy (STC) consists on counting all the nests and false crawls from the night before in one of the most important nesting beaches for green turtles in the world: Tortuguero Beach, in the North Caribbean of Costa Rica. The information extracted through Ivan's walks is essential to continue the valuable work of the STC in the area, as well as helping the species survival at a global-scale.

LA VOZ DEL MAR: HOPE FOR HAWKSBILL TURTLES

Melissa Valle[1] and Kelly Hogan[2]
ProCosta[1], Wild Earth Allies[2]
Country: El Salvador

Along El Salvador's coast, Wild Earth Allies and ProCosta are working hand-in-hand with communities to help tens of thousands of hawksbill turtle hatchlings begin their remarkable life journeys. The team partnered up with Emic Films to capture the incredible story of the women-led team renewing hope for hawksbill turtles and coastal communities alike.
https://www.youtube.com/watch?v=mTfCbQiVSqM

TURTLE CONSERVATION IN LAMU, KENYA

Hashim Said, *WWF-Kenya*
Country: Kenya

By working with communities, including fishermen and local women's groups, WWF is helping to reduce human impact on marine turtles by monitoring and protecting nest sites.
https://www.youtube.com/watch?v=wpjH0Fzrz-g

BRIGADA COMUNITARIA TORTUGUERA DE PUERTO MORELOS

Erika Yazmin Hernández Ortiz, *CONANP. Parque Nacional Arrecife de Puerto Morelos*
Country: México

Muestra del trabajo de integrantes de la comunidad de Puerto Morelos en el monitoreo y conservación de las tortugas marinas en alianza con el Parque Nacional Arrecife de Puerto Morelos.
https://fb.watch/iwX2LP-lAu/

SEA TURTLE RESEARCH AND CONSERVATION IN THE BIJAGÓS ARCHIPELAGO

Rita Patrício, *MARE - ISPA, Portugal*
Country: Guinea-Bissau

Poilão Island, located in the magical Bijagós Archipelago of Guinea-Bissau, harbours one of the largest green turtle rookeries in the world. An average of 27,000 clutches are estimated to be laid per year, in this tiny island. The nesting beach is been monitored by the Institute of Biodiversity and Protected Areas of Guinea-Bissau, the IBAP, since the year 2000. MARE-ISPA has been a research partner of the IBAP for over ten years, and this video tells a little about our research on the post-nesting migrations of this major population.
https://www.youtube.com/watch?v=YUgFImYA3iU

MENOS PLÁSTICO ES FANTÁSTICO EN MAHAHUAL

Ana Antillanca Oliva, *Menos plástico es fantástico AC*
Country: México

"Los residuos sólidos es un hecho real que acontece a nuestros tiempos. El consumismo está contaminando nuestras vidas, y a veces, no somos conscientes de ello realmente. La gente en la ciudad no ve la problemática de su basura. Cree que tirándolo a un contenedor desaparece, y no es así. Gran parte de esos residuos acaban enterrados en distintas partes del mundo, con la consecuente contaminación de suelos y ecosistemas. Otra gran parte, acaba en ríos y mares, contaminando el bien más preciado de nuestro Planeta. El Agua. Y a través de las corrientes marinas, llegan a distintas playas. Es el caso de Mahahual, pequeño lugar al sureste de México, dónde día tras día llega basura de distintos puntos del Caribe, y sus costas, se

convierten en un vertedero. La organización ""Menos Plástico es Fantástico"" analizó dicha problemática, y empezó a tomar medidas sobre ello en una zona de anidación de tortugas marinas. Primer paso, concientización e informar a la comunidad, Reducir el consumo y reutilizar los residuos, o transformarlos en productos."
https://www.youtube.com/watch?v=VTUuyDt6rNg

THE BANC D'ARGUIN IN MAURITANIA, A MAJOR FORAGING GROUND FOR GREEN TURTLES

Rita Patrício, *MARE – ISPA, Portugal*
Country: Mauritania

The National Park of the Banc d'Arguin, in Mauritania, is the largest marine protected area in West Africa, covering 12,000 square kilometres. It has vast seagrass meadows, and it is a major feeding ground for juvenile and adult green turtles, including turtles that breed in the Bijagós Archipelago, in Guinea-Bissau, 1000 kilometers south. Data from satellite tracking and in-water captures - conducted with the help of the local Imraguen fishers - indicate that around 150 thousand green turtles forage in the waters of the park, making this an area of global importance for the conservation of this species.

STRENGTHENING SEA TURTLE CONSERVATION IN COLOMBIA

Juan Manuel Rguez-Baron[1] and Roderic Mast[2]
JUSTSEA Foundation[1], Oceanic Society[2]
Country: Colombia

Join biologists Juan Manuel "Juanma" Rguez-Baron and Rod Mast as they retrace the steps of Rod's sea turtle research in Colombia in the 1980s when foreigners were seldom seen on Colombian beaches, sea turtle meat was common on restaurant menus, and trade in hawksbill shell was open and international in scale. Many risks to sea turtles are still present, but Colombian environmental authorities, conservationists, coastal residents, and national and international tourists now actively participate in conserving green, hawksbill, loggerhead, and leatherback turtles on Colombia's Caribbean shores. In this short film, Rod and Juanma discuss the challenges and benefits of sharing data. The film was written, directed, and produced by acclaimed filmmaker Elliot Blumberg.
https://www.youtube.com/watch?v=Mi-IkWzB8qE&t=3s

MONITOREO TORTUGA CAREY COZUMEL

Roberto Luis Herrera Pavón, *El Colegio de la Frontera Sur- Chetumal*
Country: México

Se muestra el trabajo de campo para la captura y estudios biológicos de la tortuga carey en las aguas de la isla de Cozumel, Quintana Roo, México, que es un destino turístico internacional para buceo. Se habla de la problemática de la especie y las acciones que se deben realizar para la conservación de la tortuga carey.
https://www.youtube.com/watch?v=IZUq0HhqXoI

FIRST SEA TURTLE RESEARCH SURVEYS IN CARRIACOU, GRENADA

Paul Jobsis, Kate Charles, and Kenrith Carter, *University of the Virgin Islands*
Country: Grenada

This collaboration of The Hawksbill Project, Ocean Spirits and the University of the Virgin Islands is the first documented research survey of sea turtle in the waters around Carriacou. The video documents the importance of using research partnerships with local environmental organizations, local fishermen and their knowledge to ensure a successful research project. Sustained research efforts require partnerships with

local environmental partners, like Ocean Spirits, to ensure the success of the mission and benefit the local population.
https://www.youtube.com/watch?v=X_IKwvDV2fM&ab_channel=VIEPSCoR

OPEN SEASON DOCUMENTARY TRAILER

Kenrith Carter and Kate Charles, *Ocean Spirits Inc.*
Country: Grenada

"Hawksbills and green sea turtles travel thousands of miles to feed and nest among Grenada's offshore islands. Yet, in the face of extinction, they remain largely unprotected, enduring one of the Caribbean's longest open hunting seasons. Open Season is the story of a dedicated team of freediving fishermen and researchers working tirelessly to protect Grenada's remaining sea turtles in one of the last true ocean wildernesses of the Eastern Caribbean. A film by Nicolas Winkler in association with Ocean Spirits (oceanspirits.org) and in collaboration with the fishermen of St. Patrick's and wildlife veterinarian Dr. Kenrith Carter DVM."
https://vimeo.com/798999187

KARUMBÉ EN TIKTOK: LOS VIDEOS MÁS VIRALES SACANDO EPIBIOTA

Alejandro Fallabrino, *Karumbé ONG*
Country: Uruguay

"Karumbé utiliza la herramienta de TIKTOK para difundir y educar sobre el trabajo de conservación de las tortugas marinas."

PRIMERA ECLOSIÓN DE TORTUGA LAÚD EN ECUADOR

Kerly Briones, *Fundación Contamos Contigo Ecuador*
Country: Ecuador

Resumen del proceso de puesta, marcaje y eclosión de la primera nidada de tortuga laúd en Ecuador.

FISHERMEN "THE CORNERSTONE OF MARINE TURTLE CONSERVATION"

Hamed Mallat, *Sfax Faculty of Sciences*
Country: Tunisia

This video was created as part of the activities of the project Life Medturtles in Tunisia to demonstrate the importance of the role of the fisherman in the rescue of marine turtles. It depicts the steps of good practice taken by the fisherman who saved a marine turtle that was accidentally caught in its fishing gear.

TORTUGAS, POESÍA AL MAR

Gilberto Borges Guzman, *Fundación AVISTA, AMVT, ProOcean*
Countries: Brasil, Venezuela, Costa Rica

Tortugas, poesía al mar, es un video dedicado a la conservación de las tortugas marinas, y trasmitida especialmente a niños en Brasil, para dar un mensaje a través de la poesía para que llegue mas fácil a las personas. Se usaron fotos de tortugas marinas en Venezuela, Costa Rica, Brasil y España, de las experiencias en campo del médico veterinario, Gilberto Borges.

CAYMAN TURTLE CENTRE'S CONSERVATION EFFORTS

Vandanaa Baboolal, *Cayman Turtle Conservation and Education Centre*
Country: Cayman Islands - Grand Cayman

Video highlighting the different types of turtle releases done by the centre.

NELSON MANDELA UNIVERSITY TURTLE TROTTERS

Amanda Robbins, *Nelson Mandela University*
Country: South Africa

This is a recap of the final March 2020 field trip to Bhanga Nek. During this trip the first case of covid was detected in South Africa and so we only managed to collect data for a few days. This footage reflects the research station, study site, and field work of the postgraduate marine turtle lab at Nelson Mandela University. Although the footage was captured in a few days time, it is a good reflection of the season's hatchling and nest check field work.

CRETACEUSPARK

Diana del Pilar Ramirez, *Fundación Tourtugas*
Country: Colombia

A brief summary of an inclusive environmental education project on turtles, with deaf people exploring the history of turtles in Colombia, including the oldest sea turtle fossil discovered to date. This project was carried out in collaboration with the Jaime Duque Park Foundation. Spanish description below.

Breve resumen de un proyecto de educación ambiental inclusiva tortuguera, con personas sordas a través de la historia las tortugas en Colombia, incluyendo el fósil de tortuga marinas más antiguo descubierto hasta la fecha. Este proyecto fue realizado en conjunto con la Fundación Parque Jaime Duque.
https://www.youtube.com/watch?v=5PEgPXqmBs4

CAMPAMENTO ASUPMATOMA: 1995-2022

Rene Pinal and Abilene Colin, *ASUPMATOMA A.C.*
Country: México

This video is part of a larger documentary that explains in detail each of the activities of a turtle camp. The goal is to be a useful resource for schools in the Los Cabos community, including those furthest from the coast. This excerpt provides a brief summary of our sea turtle conservation work, as well as some of the achievements we've made over 28 years of uninterrupted work. Spanish description below.

Este video forma parte de un documental más amplio en el que se explica a detalle cada una de las actividades de un campamento tortuguero. El objetivo es que sea un recurso útil para llevarlo a las escuelas de la comunidad de Los Cabos, incluyendo a las más alejadas de la zona costera. En este extracto, se muestra un pequeño resumen de nuestra labor de conservación de las tortugas marinas, así como algunos de los logros alcanzados a través de 28 años de trabajo de manera ininterrumpida.
https://youtu.be/49ShexNw5FM

PROYECTO DE CONSERVACIÓN DE TORTUGAS MARINAS EN PLAYA LA BARQUETA, PROVINCIA DE CHIRIQUÍ

Juan Blas and Cristina Ordoñez, *Universidad Autónoma de Chiriquí*
Country: Panamá

This video highlights the sea turtle species that nest in our country, their importance, and the threats they currently face. This has led us to use hatcheries as the best alternative for protecting nests. This is a non-profit partnership between the UNACHI university group (ACOTMAR) and the community-based Fundación Rastros de Vida (Traces of Life Foundation). It focuses on national and international environmental education, scientific research, and sustainable tourism development involving community members. Spanish description below.

El presente vídeo hace énfasis en las especies de tortugas marinas que anidan en nuestro país, su importancia y las amenazas que sufren en la actualidad, lo que nos ha llevado al uso del vivero como la mejor alternativa para la protección de los nidos. Es un proyecto sin fines de lucro, de alianza entre el grupo universitario (ACOTMAR) de la UNACHI y la Fundación Rastros de Vida de base comunitaria, enfocado a la educación ambiental a nivel nacional e internacional, investigación científica y el desarrollo turístico sostenible involucrando a los miembros de la comunidad.
https://www.youtube.com/watch?v=GbT7T4IsSz8

TURTLE SCOTT

Scott Crystal, *Save The Turtles Playa Venao*
Country: Panamá

This video discusses the conservation efforts being made in Playa Venao to Save the Turtles - especially Olive Ridleys that face all the hazards and obstacles human’s cause.
https://www.youtube.com/watch?v=2DaaA614RNc

VIVIENDO CON PASIÓN EN SAN CRISTOBAL

Zulema Guevara Oviedo, *Rancho San Cristobal*
Country: México

Can you imagine protecting endangered species in your office? And also seeing marine mammals, fish, and birds, and being able to close out your day with dreamy sunsets? This is possible in San Cristobal! Without a doubt, following your dreams and listening to your heart leads you to live with passion day after day. Spanish description below.

¿Te imaginas que en tu oficina protejas especies en peligro de extinción? y además, ¿puedas ver mamíferos marinos, peces y aves, y puedas cerrar tu día con atardeceres de ensueño? ¡Esto es posible en San Cristobal! Sin duda alguna, el seguir tus sueños y escuchar a tu corazón, te llevan a vivir con pasión día tras día.

BANGKARU SEA TURTLE CONSERVATION PROGRAM - CURRENT STATE AND THREATS

Pavel Zoubek, *Zoo Liberec / Ecosystem Impact*
Country: Indonesia

Bangkaru island is considered as a one of the most important nesting sites for green turtles on Sumatra and simultaneously a place where leatherback turtles nest. The remoteness of Bangkaru helps to preserve it's intactness, but at the same time brings challenging conditions to the program. Still, the ecological importance of the island as a whole is invaluable and therefore continuation of the program is crucial for the preservation of the wilderness of the island. The video tries to summarise the current state of the program and threats it faces.

A JOURNEY TO NORTHERN CHILE: LOOKING FOR LEATHERBACKS

Ilia Cari, *Instituto de Fomento Pesquero*
Country: Chile

This is a short summary of my first hand-to-hand experience with sea turtles in northern Chile in the framework of the project "Reduce bycatch of Eastern Pacific leatherbacks in longline fisheries of northern Chile" funded by the National Fish and Wildlife Foundation and executed by IFOP (Chile) and Marviva Foundation (Costa Rica). The implementation of the project was not easy, the objective of testing circle hooks to reduce sea turtle bycatch in the longline fleet encountered some obstacles to getting afloat, but finally, we managed to reach port safe and sound as well as the sea turtles that were released in the waters of Arica, in the extreme north of the country.
https://youtu.be/8ZXrdMSoc8E

OCA IN TAIWAN

Rosa Hsieh, *OCA, Taiwan*
Country: Taiwan

The video showcases the Ocean Conservation Administration's (OCA) efforts to protect marine ecosystems and engage with local communities in Taiwan. The OCA conducts various marine conservation and environmental projects, such as coral restoration, sea turtle conservation, and ocean waste management. The administration also works closely with local communities to raise awareness about the importance of marine conservation. The video highlights the OCA's commitment to protecting Taiwan's rich marine biodiversity and fostering a sustainable future for the island's coastal communities.

INCINERACION DE LAS CONCHAS. UNA NUEVA ACCION DE CUBA POR LA CONSERVACION

Raidel Borroto, *Centro de Investigaciones Pesqueras*
Country: Cuba